Creation Research Society Quarterly

Haec credimus:
For in six days the Lord made heaven and earth, the sea, and
all that in them is, and rested on the seventh. — Exodus 20:11

VOLUME 34 JUNE 1997 NUMBER 1

THE TARANTULA AND THE TARANTULA HAWK WASP SHOW THE CREATOR'S BALANCE IN NATURE

CREATION RESEARCH SOCIETY

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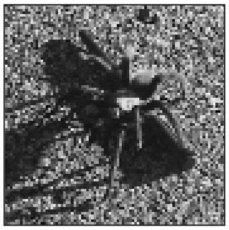

by Robert L. Goette. Several tarantulas (*Dugesiella echina*) were seen during a CRS expedition to the Chihuahuan Desert. For Williams' and Goette's photo essay on how these creatures illustrate God's handiwork, turn to p. 3.

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by Carl R. Froede, Jr. is of Bear Creek Canyon in Georgia—see article p. 38.

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Creation Research Society Quarterly is indexed in the *Christian Periodical Index.*

Creation Research Society Quarterly is published by the Creation Research Society, P.O. Box 8263, St. Joseph, MO 64508-8263.

Send papers on all subjects to the Editor: Eugene F. Chaffin, 715 Tazewell Ave., Bluefield, VA 24605.

Send book reviews to the Book Review Editor: Don B. DeYoung, 200 Seminary Dr., Wino Lake, IN 46590.

Printed in United States of America.

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History The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (with graduate degrees in science) and about 1100 nonvoting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as the outstanding publication in the field.

Activities The society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and ha no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. The Society operates The Van Andel Creation Research Center in Chino Valley, Arizona.

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Statement of Belief members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.

4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The account of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

Editor's Comments

In the editorial and review process of the *Creation Research Society Quarterly*, we study and accept some information which is provided by evolutionists. However, we do not solicit recommendations based on evolutionary philosophy or allow evolutionary worldviews to dictate what is published in our journal. We cannot be involved in a binding partnership with evolutionists. Consider the following statement from Scriptures:

> 1 Corinthians. 6
> 1. Dare any of you, having a matter against another, go to law before the unjust, and not before the saints?

Since we thus need the recommendations and suggestions of creationist reviewers, we naturally would love to be contacted by creationists who have some expertise to offer in the peer review process, but are not presently on the peer review list. If you fit this category, please write to the editor offering your assistance. It will be greatly appreciated!

In this issue, Dr. John Byl offers some constructive criticism of Dr. Russell Humphreys' recently proposed young-universe cosmology. This article was reviewed by two reviewers with Ph.D. degrees in theoretical physics. Since the editor's degree was also in theoretical physics, the article received criticism from the editor as well. After revision, the reviewers both recommended publication. Since the editor still had some reservations, Dr. Humphreys was asked to write a letter of response to the article, which appears immediately following the article. I think I can speak for all concerned when I say that the article and letter will point to some fields for further research.

An article by Edward Boudreaux in this issue shows some of the fallacies in the oft-repeated idea that life on other worlds might be based on silicon chemistry rather than carbon. Dr. Jerry Bergman reviews Darwin's natural selection idea as related to the now-extinct, flightless Dodo bird and the passenger pigeon. We are happy to publish an article from a new face - geologist Allen C. Bartlett. He comments on the relevance of sequence stratigraphy to creation models. Carl Froede adds a couple of interesting Panorama Notes related to emplacement of granite and formation of Cloudland Canyon, Georgia.

We are also pleased to be able to offer several book reviews and letters to the editor, which comment on a variety of fields of interest. We hope that Creation Research Society Members will continue to promote this *Quarterly*, whereas I believe we all agree it needs wider dissemination than it now has.

Eugene F. Chaffin, Ph.D.
Editor

PHOTO ESSAY

"Tarantula Goes Acourtin', and He Does Roam"

There seems to be something different to observe every time one visits the Chihuahuan Desert in Big Bend National Park. During the rainy summer season, the millipede *(O. ornatus)* may be seen swarming over the desert pavement (Williams, Howe and White, 1991). When doing field work in December, 1995, we crossed paths with several tarantulas *(Dugesiella echina)* looking for mates (Figures 1 and 2).

These large, hairy spiders are often employed by Hollywood in scenes to frighten an audience. The creatures do appear fearsome when one observes them. However, their bites are relatively harmless to man and they are not very aggressive. Often they are kept as pets and books have been written on how to take care of them.

Tarantulas are carnivorous, generally preying upon smaller invertebrates and occasionally on small snakes, frogs, and birds. Catching their prey, they inject the victim with venom and suck the liquids from the body. Such an arthropod may appear to be invincible acting only as a predator, but not so.

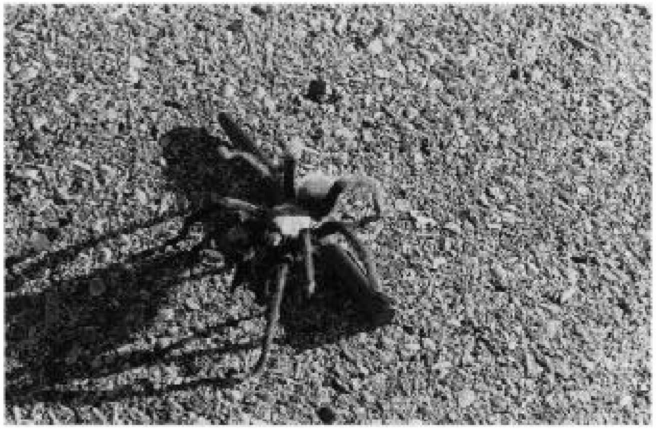

Figure 1. Tarantula *(Dugesiella echina)* on a paved road straddling a 5.3-inch hall point pen. The creature's shadow makes it look even more fierce.

Likely, the Chihuahuan Desert tarantula's deadliest enemy ". . . is a large orange and velvet blue wasp *(Pepsis formosu)* commonly known as the tarantula hawk" (Wauer,

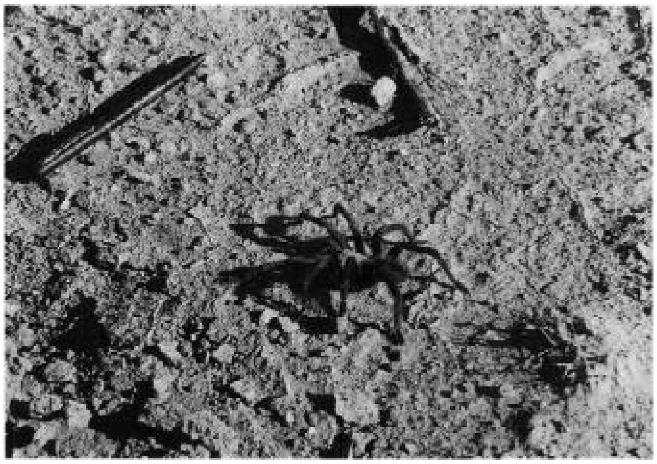

Figure 2. Tarantula *(Dugesiella echina)* on the desert pavement. A 5.3-inch ball point pen is used for scale.

1988, p. 107). The "hawk," using its venomous stinger, paralyzes the tarantula and buries it after laying an egg on the victim. When the wasp egg hatches, the young larvae feed on the paralyzed prey" (Davidson, 1991, p. 292). Thus the balance in nature, maintained by an all-wise Creator, often is seen in a prey-predator relationship.

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Emmett L. Williams
Robert L. Goette

Malachite Majesty Meditation

July 4, A.D. 1996
@ "A Wild Rose" Bed and Breakfast, Coram, Montana
[just outside of West Glacier National Park
after hiking from the Trail of the Cedars to Avalanche Lake]

Though aspens oft are new growth leaders,
West Glacier now has tall, tall cedars;
Titans green that pierce the sky,
Trapping sunlight storeys high;
The forest floor is far below,
Watered well from melted snow;
Sporting ferns and bryophytes,
And flowers bright like acolytes;
Squirrels scamper in the brush,
A bird flees, startled - it's a thrush!

Glacial ice and alpine snow
Melt below the warming sun;
Drop by drop it down will flow,
Faster, faster, cascades run;
Lotic waters rushing down,
Splashing green and scouring brown;
A mobile home for fish that spawn,
Aquatic bugs, too, zip! - they're gone!
Riverine waters cool the breeze,
Birds harmonize by two' and three's;
Airborne bugs flit about nearby,
Swallows' prey, eaten on the fly!

The river rushes clear and clean,
Yet lentic lakes have some green . . .
Is it mirroring from a piney hill?
Or phytoplankton's chlorophyll?
My eyes return to trees and ground,
I note that larch and pine abound;
As sunlight on the river shines
My path is flanked by lodgepole pines . . .
What's that? - movement? behind that tree?
Is it *Ursa*[1]*?* - stalking me?
A fellow-hiker? - boy or girl?
Whew! Thank God! It's just a squirrel!
Little creature! - I must smile . . .
He lives in quite a domicile;
For his niche, this wood is right,
From forest floor to lodgepole height;
How could I dream up such a home?
Much less design this whole biome?
What a home with many neighbors,
Each one busy with its labors;
Even nurse logs play a part,
cradling seeds that need a start . . .

This ecology I see
Speaks of teleology;
As this West Glacier under-storey
Shows me God's providential glory.

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[1] Ursa = the scientific genus name for a bear

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SEQUENCE STRATIGRAPHY: VALUE AND CONTROVERSY—FOR WHOM?

Allen C. Bartlett*

Received 20 November 1995; Revised 27 June 1996

Abstract

The secular questioning of the quietism of Lyell, Darwin, and modern geology in general is responsible for the revolution in stratigraphy and sedimentology begun in 1977. This revolution is known as sequence stratigraphy.

Sequence stratigraphy (the classical Exxon approach) is compatible with creationist Flood geology. Sequence stratigraphy is a non-time-dominant method of doing geology. Strict uniformitarians (non-catastrophists) hate sequence stratigraphy. Sequence stratigraphy is a threat to traditional uniformitarian ***formation-scale*** *or the grain-by-grain building-up and tearing-down of the land. Beyond classification of sequence stratigraphic units within a new language for geology, this less contrived philosophy of sedimentary analysis potentially offers the dynamic of short-term sea-level changes superimposed upon a single broad long-term sea-level curve (Wilgus, Hastings, Posamentier, Van Wagoner, Ross, and Kendall, 1988). By extension, the Vail curve of sea-level change (cycles within cycles) represents an exponentially based event (non-biased)* ***devoid*** *of cumbersome, intellectually restricting appeals to uniformitarianism—either uniformity of rate or material conditions (earthly agents alone)* ***or*** *mad assertions about space and time, invariance of natural laws (the exclusion of providence).*

The failure of orthodox uniformitarianism is permitting, in the secular scientific literature, a return to the philosophy of ***katastrophe*** *(Gk.: to overturn), this time expressed in terms of "extraterrestrial causes." The existential dichotomy, first described by Schaeffer (1968, 1976; 1968, 1977; 1972, 1976; 1976), has brought us to this present marvelous state of affairs in the history of science.*

Introduction

The creationist and Flood geologist Carl Froede, Jr. (1995, p. 92) envisioned the formation of a Commission of Creationist Stratigraphy responsible for defining and refining a concept of stratigraphy reflecting the world-wide catastrophic Flood event set within the context of the young Earth model. In his historic analysis of sequence stratigraphy, Froede (1994) announced his intent to follow his early attempt at understanding the sequence stratigraphic approach with studies of specific sites and their interpretation in terms of sequence stratigraphic concepts. These concepts, Froede (p. 142) suggested, are potentially "relevant and easily adapted for use by creationists."

What followed, however, was Davison's (1995) two-year study emphasizing field work in South Africa and secularly published data of additional sites on five continents. Ultimately, Davison concluded in favor of the importance of unconformity-bounded sequences (the Exxon approach) in what he termed "Flood stratigraphy": The presence of five inter-regional unconformities are world-wide in extent indicating the possibility of regionally or globally-controlled tectonic (including volcanic), tidal, eustatic, and hydraulic activity which controlled sedimentation during the Genesis Flood.

Froede (1994) and Davison (1995) appropriately rejected the constraints of uniformitarian time evident in the modern, secular sequence stratigraphic approach. However, it may surprise Froede and Davison and Flood advocates in general to find that sequence stratigraphy is a non-time dominant method of doing geology. Indeed, according to the original Exxon team (Van Wagoner et al., 1988, p. 39), the overview, fundamentals, and key definitions behind the sequence approach are time independent: i.e., the amount of time during which strata form is *not* used to define rock relationships within a chronostratigraphic framework (essentially *any* timescale) wherein the succession of rocks is cyclic and composed of genetically related stratal units (sequences and systems tracts): "Absolute thickness, the amount of time during which they form, and interpretation of regional or global origin are *not* used to define sequence-stratigraphic units.'' (Van Wagoner et al., 1988, p. 39—italics mine.) This may be interpreted as an admittance by the originators of sequence stratigraphy, many of whom indicate influence by creationist-Flood scientific studies, that time, as it pertains to the study of geology, is only an inference. Treating time as an inference is the first dismissal 4 of substantive geologic time (rate) implying extraordinarily long duration or remoteness of the past (with no precise limitations) as irrelevant, i.e. philosophically separated (dichotomized) from material process. The resulting dichotomy is diagrammed as:

$$\frac{\text{time}}{\text{process}}$$

In accounting for lithological variation in vertically stacked sequences, sequence stratigraphy emphasizes cyclic (repetitive) processes (not necessarily environments) of deposition behind independently occurring, scalarly (quantitatively) differentiated sedimentary packages evidencing distinct, abrupt, non-transitional boundaries (Figure 1). In this context, sequence stratigraphy is remarkably non-time domi-

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*Allen C. Bartlett, B.S., Department of Geology, Baylor University, Waco, Texas 76798.

nant. The Exxon approach (see Appendix I) to sequence stratigraphy is the greatest secularly orientated theoretical breakthrough useful to creationist/Flood advocates since the appearance of modern plate tectonics. Creation/Flood advocates are able to learn from the *presently* dominant secularist opposition albeit well within the principle of young Earth dynamics.

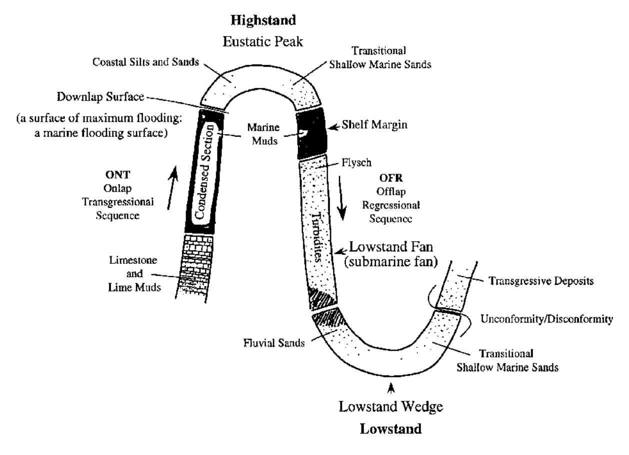

Figure 1. The sequence curve. A model of key surfaces and the corresponding distribution of lithofacies. The sequence curve occurs in; varying scales from the continental to puddle (Weimer and Posamentier, 1994, p. 10). the emphasis is upon sedimentary or hydrodynamic processes rather than upon time or ecological environment. (Adapted from Loutit et al., 1988, p. 203; fig. 24A).

Froede's (1994) and Davison's (1995) declaration rejecting the uniformitarian context of sequence stratigraphy emphasized the secularist's dependence on the evolutionary geologic timescale. Indeed, Froede (1995) proposed a creationist geological timescale including whole new units, groups, divisions, and timeframes. However, a new system of time reference is wastefully repetitious.[6] Likewise, Davison's (1995, p. 224) suggestion that "creationists need to reinterpret the *rocks,* and not the evolutionists' interpretation of these rocks" moves us dangerously back to square one—to the days preceding William "strata" Smith (1769-1839).

Instead of proposing a new geological timescale or starting the discipline anew from some obscure position further convoluting the creationist appeal, creationist/Flood advocates should seize and take control of the present secularist debate regarding *global catastrophe*—a philosophic appeal—having made its official debut in the uniformitarian (quietist) literature with the proposal offered by the Alvarez group (Alvarez, Alvarez, Asaro, and Michel, 1979; 1980). In this sense, the above citation of Van Wagoner et al. (1988, p. 39) is only partially correct. Time should *not* be used to define sequence-stratigraphic units. *Interpretation of global origin should now be used to define and describe sequence-stratigraphic unit types.* This interpretation should include the development of a mechanism in opposition to exclusivistic extraterrestrial causes (hypervelocity meteoritic impacts). It should be comprehensive in scope and involve a method of rapid subsidence or limited uplift of continental margins in tandem with rapid vertical expansion (sea-level rising) or abrupt contraction (sea-level lowering) of mid-oceanic ridges (thermo-tectonics[1]) and accompanied during (but not confined to) the Pleistocene by worldwide climatic change. In this sense, uniformitarianism should now be understood not as a declaration of *time* but as an epistemology, a philosophy of *katastrophe* emphasizing periodicity. From the creationist/Flood perspective this position is still incorrect, but the appearance of the "Alvarez hypothesis" and recently its extension with Shaw's (1994) application of nonlinear dynamics (chaos science) and celestial mechanics to resonances of the cosmos[2]—a new theory of earth—with emphasis upon global catastrophe and extinction is nevertheless an improvement upon the *quietism* of Charles Lyell (1797-1875). How did we get to this marvelous present state of affairs?

What's the History of Sequence Stratigraphy?

Sequence Stratigraphy: Talking Points. Andrew D. Miall (1986, p. 131) was among the first to suggest that "Peter Vail and his colleagues at Exxon have brought about a revolution in stratigraphic thinking; during the last ten years" (see Vail, Mitchum, and Thompson, 1977b; Vail et al., 1977c). In a pivotal publication, Richard K. Olsson (1988, p. 289), suggested that "the development of sequence stratigraphy" began with Vail et al. (1977b). To the contrary R. J. Weimer (1993, p. 1578; 1994, p. 1446) incongruously wrote: "Sequence stratigraphy was originally defined by L. L. Sloss[3] as the study of genetically related strata that are bounded by unconformities."

Henry W. Posamentier and Paul Weimer (1993, p. 731; n. 4) reported that many different concepts and definitions exist for *sequence stratigraphy* and they ask, 'of what does it consist?' Among these, to name a few, are genetic stratigraphic sequences (Galloway, 1989a; 1989b), depositional episodes (Frazier, 1974), allostratigraphy (North American Commission on Stratigraphic Nomenclature, 1983; Walker, 1990), and transgressive-regressive cycles (Embry, 1990) (see Appendix I). These stratigraphic concepts and associated nomenclature have been merged in the literature, causing confusion among workers, especially in their application to exploration and field development problems.

Zhang, Wornardt, and Vail (1992, p. 1472) wrote:

> Sequence Stratigraphy has evolved [Vail, Mitchum, and Thompson, 1977a; Wilgus et al., 1988; Posamentier and Vail, 1988; Posamentier, Jervey, and Vail, 1988] from a theoretically controversial model into a practically accepted method. Currently there is a tremendous amount of interests [sic] in practicing sequence stratigraphy with different approaches being employed by various researchers [see Appendix I].

Posamentier and Weimer (1993, p. 731) elaborated that for purposes of clarity and simplicity, in their work, the term "sequence stratigraphy" would be returned to its *original* sense outlined by Posamentier and Vail (1988) and Van Wagoner, Mitchum, Campion, and Rahmanian (1990)—the Exxon approach.

To realize the full potential of the sequence stratigraphic approach, Posamentier and Weimer (1993, p. 739) recommended the following readings: Vail et al. (1977a); Haq, Hardenbol, and Vail (1987); Jervey (1988); Posamentier et al. (1988); Posamentier and Vail (1988); and Van Wagoner et al. (1990). Posamentier and James (1993) provided an overview of sequence stratigraphic concepts, uses and abuses. Answering critics,[4] Weimer and 9 Posamentier (1994) focused on refining the conceptual model of sequence stratigraphy and documented the revolution in stratigraphic analysis as entering "a phase of intense application" (p. 3) in the petroleum industry. Extensive compilations of case studies using the sequence stratigraphic approach include MacDonald (1991), Einsele Ricken and Seilacher (1991), Posamentier et al. (1993), Loucks and Sarg (1993), and Weimer and Posamentier (1994).

Sequence Stratigraphy: What is it?

Bilal U. Haq, Jan Hardenbol, and Peter R. Vail (1987, p. 1165; n. 9)—the fathers of the revolution known as *sequence stratigraphy*—cite Mitchum, Vail, and Sangree (1977), as the earliest, most salient treatment of sequence stratigraphy in answer to the question, "What is it?" Haq et al. (1987, p. 1165; n. 9) characterized the word *sequence* in *sequence stratigraphy* in terms of cyclic sedimentation:

> Sequence is a widely used term in earth science, but here sequence refers specifically to the depositional sequence or the succession of sediments deposited during a complete sea level *cycle,* that is, from a sea level fall to subsequent rise and ending with the next fall [see, p. 1157; Figure 1].[5] Sequence stratigraphy is broadly defined as the branch of stratigraphy that deals with depositional sequences of genetically related strata deposited during the different phases (lowstand, transgressive, and highstand) of sea level *cycles*. (Italics mine.)

Van Wagoner et al. (l988, p. 39)—discussing the definition of sequence stratigraphy (the classical Exxon approach) with subsidiary aspects—noted that:

> **Sequence stratigraphy** is the study of rock relationships within a chronostratigraphic framework of repetitive, genetically related strata bounded by surfaces of erosion or nondeposition, or their correlative conformities. The fundamental unit of sequence stratigraphy is the **sequence,** which is bounded by unconformities and their correlative conformities. A sequence can be subdivided into **systems tracts,** which are defined by their position within the sequence and by the stacking patterns of **parasequence sets** and **parasequences** bounded by marine-flooding surfaces. Boundaries of sequences, parasequence sets, and parasequences provide a chronostratigraphic framework for correlating and mapping sedimentary rocks. Sequences, parasequence sets, and parasequences are defined and identified by the physical relationships of strata, including the lateral continuity and geometry of the surfaces bounding the units, vertical and lateral stacking patterns, and the lateral geometry of the strata within these units. Absolute thickness, the amount of time during which they form, and interpretation of regional or global origin are not used to define sequence-stratigraphic units.

Van Wagoner and Hill (1994, p. 1168) reported that the importance of sequence stratigraphy is its predictive element: the effects of relative sea-level changes on lithofacies (rock suites) distribution and stratal stacking patterns are more easily, more correctly inferred. "These effects have been well documented in paralic and shallow-marine strata." Also, Shanley and McCabe (1994, p, 544) wrote, "The popularization of sequence-stratigraphic concepts during the last 15 or so years has given the geologic community powerful new tools with which to predict the occurrence and geometry of sedimentary strata."

New Truth From Old Discoveries: the Death Knell for Strict Uniformitarianism

Since the mid-1920s and 1930s geologists—Julia Gardner (1923; 1924; 1925; 1927a; 1927b; 1928; 1931; Gardner and Arthur C. Trowbridge, 1931), Esther R. Applin, Alva C. Ellisor, Hedwig T. Kniker (1925), Ellisor (1929; 1930), Helen J. Plummer (1926, 1927; 1932), Nelson H. Darton, L. W. Stephenson, and Gardner (1932), and others—have struggled with the complexities of regional correlation including problematic downdip and lateral lithofacies changes primarily through the study of foraminifera faunal types.

Other geologists since that period have puzzled over the original uniformitarian interpretations which have produced the philosophic framework referred to here as traditional *formation-scale*[6] (Davidoff and Yancey, 1993), deposition-interpretative method. This framework is loaded with paleoecologic implications used to reconstruct sedimentary environments: e.g., flood plain, swamp, beach-ridge barrier, delta-front platform mouth bar, prodelta slope, open shelf, etc.

Since the development of sequence stratigraphy (Vail et al., 1977a), however, geologic focus has shifted from formation-scale depositional history—the environments of deposition including change of rates and material conditions set within the context of strict spatial and temporal invariance—and is presently returning to “the cycles of sea-level change within which sequences are deposited” (Olsson, 1988, p. 289):

> Vail and Hardenbol (1979) used onlap-offlap sequences to derive a sea-level curve showing relative changes in sea level for the Tertiary [see Appendix II]. These relative changes in sea level are interpreted by Vail and others (1984) and Haq and others (1987) as due to eustatic changes superimposed on a long-term eustatic sea-level curve [see Vail et al., 1977b, p. 84; Figure 1:…Relative Change of Sea Level During (the) Phanerozoic; Wilgus et al., 1988, pl.: Mesozoic-Cenozoic Cycle Chart].[7] If stratigraphic sequences develop during cycles of eustatic rise and fall of sea level, knowledge of the magnitude of eustatic change is important to understanding the mechanism(s) that cause the change. Estimation of the magnitude of eustatic change relative to present sea level has been the most elusive data of all to obtain in analyzing sequence stratigraphy.

For better or for worse, the scientific investigations of the sequence stratigrapher add a whole new descriptive, more easily conveyed geologic vocabulary (see Van Wagoner et al., 1988, pp. 39-45) to the study of geology. This new vocabulary, expressive of the ideas behind sequence stratigraphy, provides a broader overview of the accurate, acceptable fundamentals of the discipline set within the context of a less contrived more forthcoming philosophy—the sequence stratigraphic approach. This revolutionary focus is generating great interest in demonstrating the cyclic and episodic nature of much of the stratigraphic record including the discovery of an acceptable theoretical mechanism driving the cycles of sea-level change.

A Timely Scientific Revolution

What were the conditions that led to this timely revolution[8] in the geological sciences? Peter M. Roth (1993, p. 1568), reviewing Einsele, Ricken, and Seilacher (1991), suggested that:

> Perhaps it was a minor revolution in stratigraphy and sedimentation, a return to Cuvillier’s [sic] [Georges Cuvier’s (1769-1832)] ideas of multiple floods and away from Lyell and Darwin, the gradualists with their peaceful view of earth’s history.

Cuvier’s Multiple Catastrophism. Georges Cuvier (1769-1832), professor of comparative anatomy at the Museum of Natural History, Paris, and the founder of modern vertebrate paleontology was a man of immense learning and reputation. Whitcomb and Morris (1961, 1973, p. 92) reported that Cuvier’s opposition to Flood geology (the dominant paradigm of early 19th century geology) was subtle, because while he insisted that the superficial deposits of the Earth had been laid down by the Biblical Flood, he also taught that the major fossiliferous strata had been deposited by a series of great floods separated by immense periods of time, long before the creation of man. After each of these catastrophes, the few surviving animals spread out over the Earth again (a sort of “punctuated” approach to variable populations)1 only to be nearly annihilated by another great flood. The last of these aqueous catastrophes was the Noahic Deluge, concerning which Cuvier, in notes for the third edition (1836, p. 133) of his *Discours sur les Révolutions de Ia Surface du Globe*, patronizingly wrote:

> If there be a fact well ascertained in geology, it is this, that the surface of our globe has suffered a great and sudden revolution, the period of which cannot be dated further back than 5 or 6000 years.

Neokatastrophism and Periodicity. Roth (1993, p. 1568) was not the first to point out the apparent renewal of cuvierism with the modern, secular interest in rhythmicity of sedimentary depositional cycles evident in both the Vail curve (Figures 2, 3) and subsidiary/oppositional Milankovitch band cyclostratigraphy (Schwarzacher, 1993). David M. Raup (1986, p. 18), noted—among others, including Otto Schindewolf (1963) (with M. W. de Laubenfels [1956]: the sometimes fathers of extraterrestrial neokatastrophism)—his own conversion. Raup and Sepkoski (1984, p. 805) suggested that “many of the major biological crises of our past, the mass extinctions, were evidently caused by the environmental shock of what is known in the trade as ‘large-body impact’.” Cornet orbits were deflected in random, periodic ways by an as yet unseen small solar companion star (Nemesis) on a highly eccentric (non-circular) orbit—an orbit that carries the companion through the Oort Cloud once per revolution about the sun Accidental, recurrent disturbance of comet orbits in the Oort Cloud then produces a comet shower on earth and the comet impacts cause mass extinction (Davis, Hut, and Muller, 1983; 1984; Whitmire and Jackson, 1984). Stanley (1987, p. 7) noted:

> . . . During the 1980s [Alvarez et al., 1980; Ganapathy, 1980; Hsü, 1980; Kyte, Zhou, and Wasson, 1980; Smit and Hertogen, 1980; Alvarez, Alvarez, Asaro, and Michel, 1982; Alvarez, 1983; Alvarez, Alvarez, Asaro, and Michel, 1984a; Alvarez, Kauffman, Surlyk, Alvarez, Asaro, and Michel, 1984b] the question of what ended the dinosaurs’ reign on earth has been much in the news because of the hotly debated hypothesis that calamitous changes wrought when a giant meteor struck the earth killed off the largest land animals of all time.

Raup (1986, p. 31) indicated: “As many readers will already have realized, the debate and argument about Nemesis is a revival of the Lyell-Cuvier argument.” Indeed, John Maddox (1984, p. 685), the editor of *Nature,* concluded by commenting: ". . . It is proper to acknowledge that the intellectual climate has changed in favour of catastrophism.

An important component in this revolution was Stephen Jay Gould's (1965) decisive but flippantly titled paper, "Is Uniformitarianism Necessary?"[9] Gould's critical analysis of the cornerstone of modern geology opened the way for the discussion of uniformitarianism as a philosophic dichotomy.[10] Elsewhere, Gould (1967, p. 51) wrote: "I [maintain] that uniformitarianism is a dual notion with two strictly separable aspects. …" Gould's (1965) dichotomy may be set out diagrammatically as:

$$\frac{\text{substantive uniformitarianism}}{\text{methodological uniformitarianism}}$$

This diagram may be amplified as follows, to show what is included on the two different levels:

substantive uniformitarianism:

(a testable theory of geologic change postulating uniformity of rates or material conditions)

methodological uniformitarianism:

(a procedural principle asserting spatial and temporal invariance of natural laws)

Francis A. Schaeffer documented the origin of humanist *philosophic dichotomy* or the existential principle[11] in his trilogy: *The God Who is There* (1968, 1976), *Escape from Reason* (1968, 1977), and *He is There and He is not Silent* (1972, 1976). Schaeffer's studies represent a thorough understanding of the history of philosophy from the gifted Christian perspective. To comprehend the humanist principle one must also be familiar with Schaeffer's book *How Should We Then Live? The Rise and Decline of Western Thought and Culture* (1976) (see chapter 9; topical index, s.v.: "dichotomy"; "story, upper and lower"). Gould's (1965) dichotomy proved the empirical reality of Schaeffer's existential principle: whatever a man *today* dichotomizes, he is about to give up *tomorrow.* The entire history of modern (humanist) western philosophy and religion is testimony to this fact.

Familiar with the philosophy of science (i.e., intellectual revolution and *factio* paradigm) originally offered by Kuhn (1962, 1970), S. J. Gould (1965, p. 223) profanely suggested:

> *Substantive uniformitarianism…is false and stifling to hypothesis formation*. Methodological uniformitarianism…belongs to the definition of science and is not unique to geology. *Methodological uniformitarianism* enabled Lyell [Charles Lyell (1797-1875)][12] to exclude the miraculous from geologic explanation; its invocation today is *anachronistic* since the question of divine intervention is no longer an issue in science. (Italics mine.)

Indeed, Gould's historic paper provided the professional impetus for further questioning of the quietism of Lyell, Darwin, and modern geology in general.

More recently, Gould (1987, pp. 176-177) provided an endorsement of the Alvarez hypothesis—a post-modernist challenge to Lyell and to the tradition of modern quietism (uniformitarianism)—when he wrote:

> . . . Lyell's rhetorical confusion might stifle legitimate research, I note Lyell's [1830, 1:39] harsh dismissal of the seventeenth-century scientist William Whiston [1696, 1708], because he dared to promote comets, and not earthly agents alone, as sources of geological change. Comets, I note, are now a favored mechanism for mass extinction under the Alvarez hypothesis [Urey, 1973; Alvarez et al., 1979; 1980; Silver and Schultz, 1982; Alvarez and Muller, 1984]: "He (Whiston [1696, 1708]) retarded the progress of truth, diverting men from the investigation of the laws of sublunary nature, and inducing them to waste time in speculations on the power of comets to drag the waters of the ocean over the land—on the condensation of the vapors of their tails into water, and other matters equally edifying . . ."

The Return to *Katastrophism,* but in Secular Attire

Besides the revolution in stratigraphy and sedimentology begun in 1977, a return to the philosophy of *katastrophe* (Gk.: to overturn)—this time expressed in terms of "extraterrestrial causes"—was first accepted after the proposal offered by Luis W. Alvarez (a Nobel laureate in physics), Walter Alvarez, Frank Asaro, and Helen V. Michel (1979; 1980). Gradualistic, earth-based causes were now out of the question. Any *true* Lyellian would have poured contempt upon the "Alvarez hypothesis." But, so it seemed, the tables were turned. A new dichotomy was evident, expressed as:

$$\begin{array}{c}\text{substantive uniformitarianism}\\ \hline \text{methodological uniformitarianism}\\ \hline \textit{katastrophism}\end{array}$$

Indeed, the principle was emerging: *that which is placed in the lower has consumed the upper.* Schaeffer (1968, 1977, p. 38) wrote:

> The lesson is: whenever you make such a dualism and begin to set up one autonomous section below, the result is that the lower eats up the upper. This has happened time after time in the last few hundred years.

Introduced here as evidence of philosophic "consumption," Gould (1965, p. 223) concludes that: "Substantive uniformitarianism, an incorrect theory, should be abandoned. Methodological uniformitarianism, now a superfluous term, is best confined to the past history of geology." I propose a new title for Gould, the neo-katastrophists, and

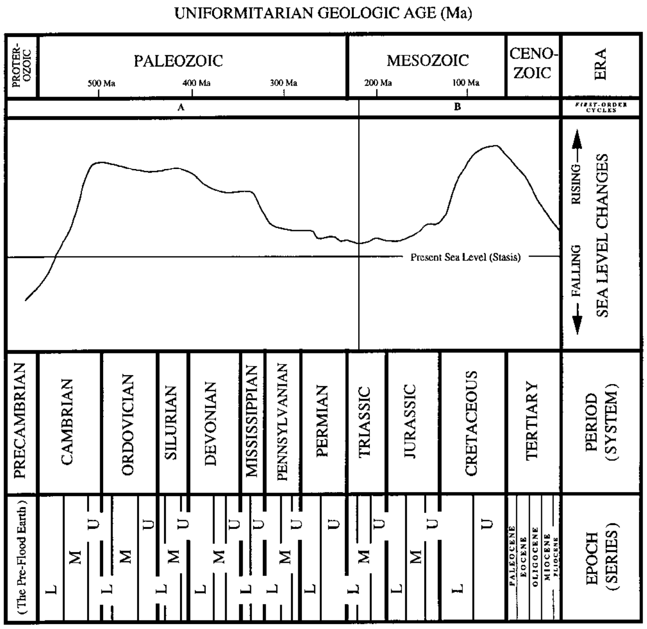

Figure 2. The sequence curve (systems tract)-the Vail curve-for the Phanerozoic (the "long-term" curve): two *type 1* depositional sequences (megasequences) first-order peaks of major transgression (during the Early Paleozoic and the Late Cretaceous). Note: (1) sea-level lowstand during the Late Precambrian; (2) distinct regression occurs throughout the Middle to Late Paleozoic and into the Mesozoic; (3) distinct regression is evident throughout the Tertiary; (4) a return to near-stasis or "bounding" (Genesis 9:11; Psalm 104:9) occurs at the end of the Tertiary. *Second* -order cycles comprise these *first* -order curves (see Figure 2).

Flood geology does not attempt to discredit the longstanding Vail curve (Vail et al., 1977b, p. 84; fig. 1), nor is there a need for reconciliation with the philosophy of Cuvier (the multi-flood approach). Instead, *first* -order cycles are viewed potentially as components of a yet much larger sequence curve (systems tract). Separate megasequences are incorporated into a *single* supermegasequence of broad world-wide extent. Evidence of this event defies descriptive accounts by uniformitarians heretofore non-forthcoming. (Adapted from Vail et al., 1977b, p. 84; fig. 1.)

the sequence stratigraphers to ponder: "Whatever Became of Uniformitarianism?"

Conclusion

Modern geology is founded upon the philosophy of uniformitarianism-the tradition of quietism. The founders of quietism were James Hutton (1726-1797), John Playfair (1748-1819), and Charles Lyell (1797-1875). "Uniformitarianism" was a word coined by William Whewell(l832). The concept, essentially naturalistic, presupposes that, "during unlimited expanses of time, the Earth has undergone slow, ceaseless changes by processes we can [presently] observe in operation" (Marvin, 1990, p. 147) (see II Peter 3:4b). Uniformitarian geology as a system defines the stratigraphic record in terms of time units. Modern geology is fundamentally time dependent. The tradition of quietism disallows things beyond the naturally occurring, denies intervening actions other than the observable and present, and refuses extraordinary events as an explanation of the common.

Stephen Jay Gould (1965) dichotomized the formerly secure system of uniformitarian geology into strongly contrasting views of invariance. The nature-versus-grace problem[13] so long plaguing universalist liberal "Christian" theology has now visited modern geology. As an example, Gould (p. 223) writes: "Substantive uniformitarianism...is false and stifling to hypothesis formation" (someone's imagination wishes to fly beyond the stars), and "Methodological uniformitarianism...is anachronistic" (since, in the view of the naturalist, God is dead). The problem is *existential* dichotomy. The result is philosophic tension. Gould's *methodological uniformitarianism* (space-time invariance) is potentially fatal to his *substantive uniformitarianism* (rate, material conditions, and ultimately periodicity) since in an existential universe there is no regularity, no uniformity (beyond the moment) to describe. This situation is not producing rationality in geology-post-modern geology. Only confusion has arisen from Gould's dichotomy, a disorderliness of the post-modern mind inflicted upon secular, geologic science.

Implications for Flood Geology. In an environment of intellectual despair-the rational end of uniformitarianism-a non-time-invariance or a time-independent geology appeared. Then sequence stratigraphy entered as a whole new way of doing geology.

Sequence stratigraphy offers to the flood geologist the concept of cycles *within* cycles of sea-level change. Far from a return to Cuvierism as some charge, large-scale sea-level changes described on the Vail curve (Figure 2) should be potentially viewed by the Flood geologist as components of a yet much larger sequence curve (supersystems tract). The overall curve incorporates large-scale sea-level change *(megasequences)* into a single *supermegusequence* (Figure 4) covering "all the high hills" (Genesis 7: 19).[14] This single event of such broad world-wide extent has until the secular development of sequence stratigraphy eluded forthcoming description by rationalistic, uniformitarian geologists. In understanding the theme of the illustration (Figure 4)-cycles within cycles comprising a still larger cycle, the idea behind each graphic presented with this paper-the Genesis Flood, the sedimentary rock record, is interpreted. Here is a powerful tool for *Diluvialists* (Woodmorappe, 1978, pp. 189-190)-the sequence stratigraphic approach: cyclic (repetitive) processes (material conditions) developed distinct scalar (quantitative) and modular (qualitative) sequence lithofacies; these lithofacies-parasequence, sequence, supersequence, megasequence, *supermegusequence* (proposed)-are evidenced (easily referenced) in the rock record from the global to continental to puddle.[15]

Creationist sequence stratigraphy describes cyclic (repetitive) processes (material conditions) overlapping into progressively larger-scale cycles. Each depositional cycle con-

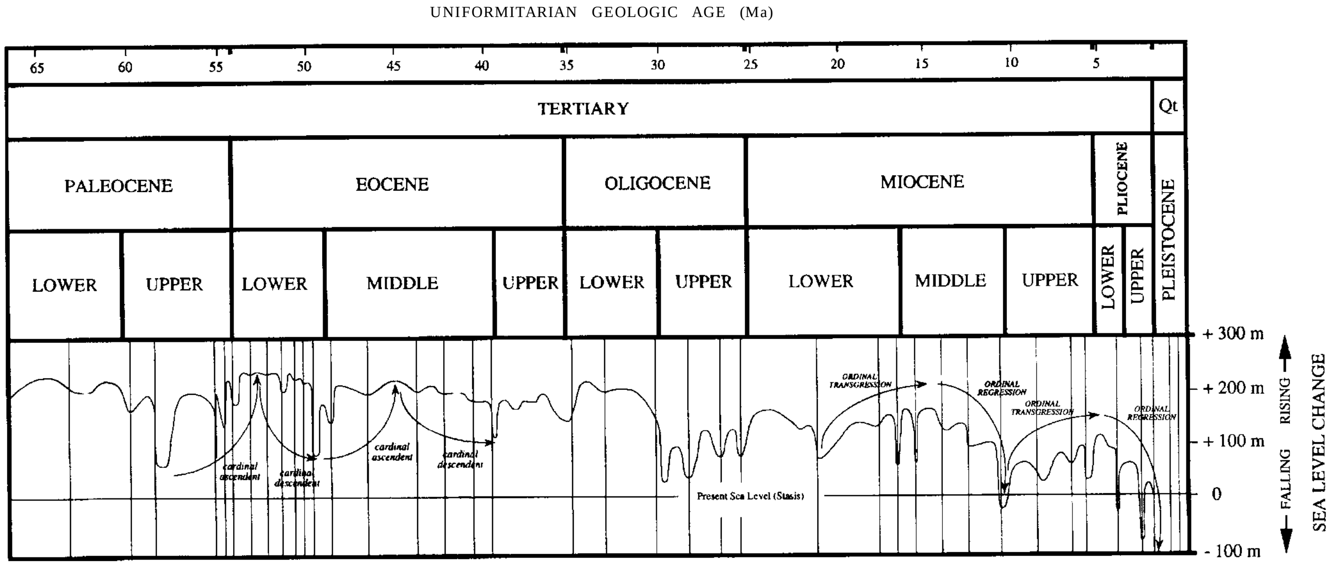

Figure 3, The sequence curve (systems tract)-the Vail curve-for the Tertiary Period only. Note the overall or general regression of sea level: ". . . The waters were abated" (Genesis 8:3,8, 11).

The lower to middle Miocene and the upper Miocene to upper Pliocene represents separate *type 2* depositional sequences (supersequences)-individual second-order cycles of *ordinal transgression* and *ordinal regression* (larger peaks and valleys). The smaller curves represent third-order *cycles* (sequences) of *cardinal ascendent* and *cardinal descendent* sea-level change: "and the waters returned from off the earth continually [in going and returning]" (Genesis 8:3a). It is the smaller *cardinal* curves (exemplified in the upper Paleocene to lower Eocene and lower to middle Eocene) that comprise the larger *ordinal* cycles, and the *ordinal* curves that constitute the broader systems tract *first-* order cycles (megasequences) depicted in Figure 2. The concept that comes forth is one of 'cycles within cycles' (Ezekiel 10:10). (Adapted from Prothero, 1990, p. 263; fig. 11.17 citing Haq et al., 1987, p. 1158; fig. 2; 1988, p. 95; fig 14.)

sists of four phases of relative accommodation change ultimately related to a fundamental change in sea level. These four phases are rising, highstand, falling, and lowstand (see Figure 1). Significant predictions and reinterpretations governing dominance of lithofacies (rock suites) associations-Paleozoic-Mesozoic-Cenozoic-may now be made with increasing success. For example, the dominance of muds occurring in the Early to Middle Mesozoic (see Figure 2) need not be considered a totally transgressive aspect (systems tract) of changing sea level. Indeed, should the definition of *condensed section* (see Glossary) always apply to massive mud deposition? Early to Middle Mesozoic mud regimes should now be viewed as shelfally derived, i.e. offlap regressional (see Figure 1). Thus, by way of example (using but one case), Woodmorappe's (1978, 1993, p. 104) adopted misuse of the term "condensed" is corrected, but his conclusion regarding "the high proportion of [mud] beds in mountains (especially the Alps) . . ." reflecting "disturbed Flood-burial patterns caused by floodwater *flow-off* variability around emerging mountains" (italics mine) is moved dramatically to a position of geologic reality. Early to Middle Mesozoic marine muds (see Figure 2) indicate an emergent, geosynclinial continental-shelf margin and therefore *offlap* regression (see Figure 1: *The sequence curve).*

Implications for Uniformitarian Geology. In surroundings of doubt governing the honesty of the uniformitarian principle, a shift in "truth' occurred. But, in fact, what post-modern geology is now saying has already been said but in a different way by the Christian creationist and Flood geologist (e.g., William Whiston [1667-1752] 1696, 1708). Gould (1987b) has suggested this in his criticism of the Alvarez hypothesis. Nevertheless, with Alvarez et al. (1979; 1980), indeed, the concept of *katastrophism* revived.

It is interesting that the Alvarez hypothesis (Alvarez et al., 1979; 1980) appeared a mere two years after the introduction of sequence stratigraphy (Vail et al., 1977a; 1977b; 1977c). Both represent revolutionary understandings, reinterpretive departures (Kuhn, 1962, 1970) from the modern view of geology. This is why I refer to the new understandings as post-modern. Further, it may be said that post-modern geology characteristically arose just 13 years after Gould's (1964) important essay.

Warnings for Creationists. Yes, *katastrophism* has revived. But it is rationalistic, humanistic *katastrophism*- geologic, world-wide upheaval in secular attire. Indeed, a close review of current literature on the impact hypothesis (Shaw, 1994) reveals a new epistemological strategy for uniformitarians: if periodicity (cosmic resonances or chaos theory) is demonstrable in the larger equation of catastrophe, then catastrophe as known by the revelationist is not catastrophic. Catastrophe becomes part of the naturalistic order of things. As Ager (1973, p. 100) said, "The history of life contains long periods of boredom and short periods of terror." From Ager's compilation and from many other contributions, the

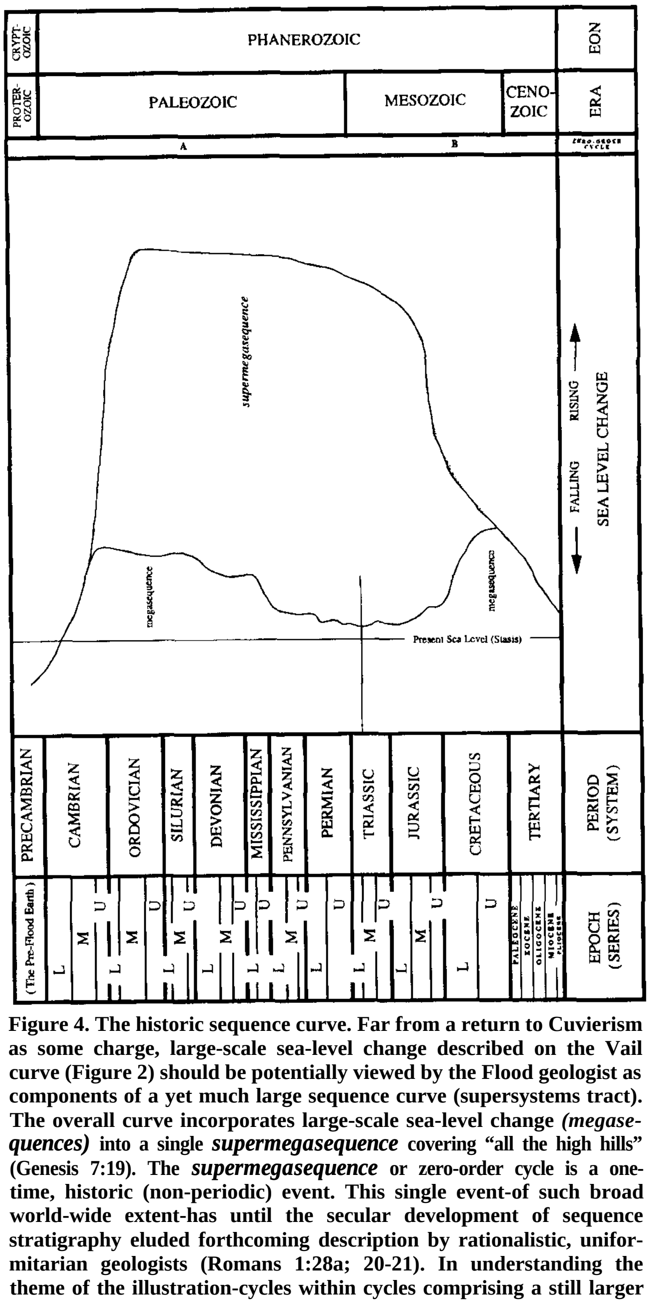

Figure 4. The historic sequence curve. Far from a return to Cuvierism as some charge, large-scale sea-level change described on the Vail curve (Figure 2) should be potentially viewed by the Flood geologist as components of a yet much large sequence curve (supersystems tract). The overall curve incorporates large-scale sea-level change *(megasequences)* into a single *supermegasequence* covering "all the high hills" (Genesis 7:19). The *supermegasequence* or zero-order cycle is a one-time, historic (non-periodic) event. This single event-of such broad world-wide extent-has until the secular development of sequence stratigraphy eluded forthcoming description by rationalistic, uniformitarian geologists (Romans 1:28a; 20-21). In understanding the theme of the illustration-cycles within cycles comprising a still larger cycle, the idea behind each graphic presented with this paper-the Genesis Flood, and thus the rock record, is interpreted.

The *supermegasequence* (zero-order cycle) is proposed as part of an ongoing program of research adaptively idealized from parameters common to standard normal (bell-shaped curve) distribution. Numerous reconstructions on a best-fit numerical scale, beginning with two known megasequences, repeatedly indicated a positive skewness to the Flood curve.

Some critics of Flood geology maintain, because at present there exists no conclusive naturalistic evidence regarding the cause or mechanics of zero-order change in sea level, that the event never occurred.

following conclusion is inescapable: "episodic processes play an important role in geology" (Gretener, 1984, p. 78). This is well and fine, but the creationist Flood geologist adds: ***"episodic*** (repetitive) processes, perhaps; but not ***periodic*** (repetitive) events."

Hypervelocity meteoritic impact or "extraterrestrial causes" for periodic extinction is presently the cloak of the rationalists,[16] Yet, and with irony (because of the criticism expressed by the post-modernists regarding their own cloak), creationists in general and Flood geologists in particular are in a good position not only to reveal the motives of mistaken theory or method (aberrant epistemological process) but to seize the moral highground of presentation-

> Hypervelocity meteorite impact is an extraordinary event, originating from outside the earth, and wreaking change instantaneously. Such a process violates every tenet of uniformitarianism...Impact processes, which have recently been cited to account for cataclysmic events such as massive tsunami deposits, incinerating wildfires, and global extinctions, carry genuinely revolutionary implications that are fatal to the uniformitarian principle itself. (Marvin, 1990, p. 147.)

Uniformitarianism is dead. Quietism is dead. Lyellian, modern geology is dead. ***Hic Jacet.***

Ex cathedra- geology and biology may now be returned to creationist roots. Genuine curiosity, the expressed rational, heartfelt honesty, are now reintroduced to discovery. This ***is*** creation discovery.

Our present call is nullification. Our job is that of a preserving influence (Matthew 5: 13). We nullify the intellectual indecencies-the miscarriage of reason. Yet our immediate concern is occupation (Luke 19:13d). This is the moral highground: (1) the annulment of the uniformitarian-evolutionary hypothesis, (2) increased involvement in the "discovery" disciplines, and (3) consequent submission of creation studies and Flood geology to a public presentation of the discovery process. It must at last be recognized, the battle is not for a ***science*** "falsely so called" (I Timothy 6:20c)-i.e., a naturalistic method towards knowledge historically occultic or hidden, gnostic or secret-but for ***epistemology.***[17]

Post Obitum. Sequence stratigraphy represents a breakout from the intellectual-philosophic Bastille of uniformitarian time.

It is not necessary for Christian creationists to revise the generalized discipline or divisions of secular geology founded upon the principle and orthodoxy of uniformitarianism. Uniformitarian geology has fallen apart from within. Of "itself"-perhaps providentially guided-the discipline of geology is transforming its own into proponents of catastrophism. The reintroduction of the Genesis Flood is soon to follow.

It does not fall to the Christian creationist to revise the uniformitarian timetable or to create a new timescale as Froede (1995) proposed. The uniformitarian-evolutionary timescale represents a corruption of and an affront to human reason offensive to creationists and secularists alike. The record of this offense, formerly buried deep within the naturalistic sciences, has surfaced. Geology seems to be embracing a "new open-mindedness."

Secularists agree that uniformitarianism is false and stifling to hypothesis construction as well as scholarly discussion. In the past, the issue was the burial of the question of divine intervention. The whole issue involves recognition of and submission to the Christian God-Jesus Christ. "We will not have this *man* to reign over us" (Luke 19:14c) was the clarion battle cry of Enlightenment scientism.

Neo-katastrophism- a belief in periodic extraterrestrial catastrophic causes (Shaw, 1994)-thinks to open a door to a post-Enlightenment or post-modernist "scientism." It *will* do this if Christian creationists fail to seize this unique moment in the history of science.

Glossary

Sequence Stratigraphy: (a) that branch of stratigraphy which subdivides the rock record using a succession of depositional sequences composed of genetically related strata as regional and interregional correlative units (Haq et al., 1988, p. 83); (b) the study of rock relationships within a chronostratigraphic framework wherein the succession of rocks is cyclic and is composed of genetically related strata1 units (sequences and systems tracts). (Posamentier et al., 1988, p. 110.)

Sequence stratigraphy...combines detailed analysis of sedimentary facies and depositional geometries, and defines a hierarchy of stratigraphic units that stack into progressively larger scale cycles. Each depositional cycle consists of four phases of relative accommodation change which can be related to relative water level change, such as sea level. These four phases are rising, highstand, falling, and low stand [see Figure 1], and the rocks deposited during each phase are called systems tracts. (Armentrout, 1995, p. 1195.)

Systems Tract: a linkage of contemporaneous depositional systems (Brown and Fisher, 1977, pp. 213-248). Each [system tract] is defined objectively by strata1 geometries at bounding surfaces, position within the sequence, and internal parasequence stacking patterns. Each is interpreted to be associated with a specific segment of the eustatic curve (i.e., eustatic lowstand-lowstand wedge; eustatic rise-transgressive; rapid eustatic fall-lowstand fan [Figure 1], and so on), although not defined on the basis of this association. (Posamentier et al., 1988, p. 110.)

Sequence: a relatively conformable succession of genetically related strata bounded at its tip and base by unconformities and their correlative conformities (Vail et al., 1977c, pp. 49-212). It is composed of a succession of systems tracts and is interpreted to be deposited between eustatic-fall inflection points. (Posamentier et al., 1988, p. 110.)

Parasequence: a relatively conformable succession of genetically related beds or bedsets bounded by marine-flooding surfaces and their correlative surfaces (Van Wagoner, 1985, pp. 91-92). (Posamentier et al., 1988, p. 110.)

Condensed section: Van Wagoner et al. (1988, p. 44) and Loutit, Hardenbol, Vail, and Baum (1988, p. 183) suggested that a condensed section or mud facies-consisting of thin, marine beds of hemipelagic or pelagic sediments-is deposited at slow rates. This is remarkably similar to the descriptions and proposals offered by a plethora of preceding uniformitarian authors, of which, the Diluvialist, Woodmorappe (1978; 1993, pp. 103-104) outlined with considerable detail (but profound reinterpretive criticism) suggesting:

> The "Condensed" sequences have an infinitely greater significance [in demonstrating]. . .mixing biostratigraphic horizons. Once "condensed" sequences are seen to be rapidly deposited, the result is nothing less than the complete collapse of all the uniformitarian time-claims ascribed to the fossil record. "Condensed" beds may potentially become the most powerful overall evidence for the cataclysmic, mutually contemporaneous, short-duration burial of the entire fossil record. (p. 104.)

Although Woodmorappe's description of mixed ammonoid populations indeed indicates condensed bedding-"correlation of these 'condensed' beds may 'condense' most of the Mesozoic, deflating its sedimentation time from hundreds of millions of years to only several weeks (the closing phases of the Noachian Deluge)" (see Figure 2)-his conclusion that "the high proportion of condensed beds in mountains (especially the Alps) reflects disturbed Flood-burial patterns caused by Floodwater flow-off variability around emerging mountains" (italics mine) is more descriptive of marine muds indicative of an emergent geosynclinal continental shelf margin and therefore *offlap regression* (see Figure 1: *The sequence curve).*

Loutit et al. (1988, p. 183) surmised that *condensed section* deposits represent a physical stratigraphic link between shallow- and deep-water sections *limited* to a single depositional sequence (a rather large depositional unit more closely related, in the traditional formational scale, to the group system) from the shelf or slope break *landward* to the distal edge of inner-neritic sand deposition.

Van Wagoner et al. (1988, p. 44) correctly pointed out that *condensed sections* are most extensive during the time of regional *transgression* of the shoreline: "The condensed section...occurs largely within the *transgressive* and distal *highstand* systems tracts" (italics mine). (See Figure 1: *The sequence curve.)*

Baum and Vail (1988, p. 317) defined *condensed sections* of coastal plain physiography as characterized by marine shales or micrites and by anomalously high concentrations of planktonic organisms, glauconite, sulfides, phosphate, and exotic elements such as iridium (see Baum, Blechschmidt, Hardenbol, Loutit, Vail, and Wright, 1984; Donovan, Baum, Blechschmidt, Loutit, Pflum, and Vail, 1988, pp. 300, 302-306; figures 1, 5, 6, 7, 8, 9, 10 at *maximum flooding surface* [MFS]).

Downlap surface: the top of the transgressive systems tract (Posamentier and Vail, 1988, p. 128; fig. 4) or transgressive sand and mud (condensed section) deposit of the sequence curve (see Figure 1; in this context limited to type 0 (supermegasequence (Figure 4)] or composites—type 1 (megasequence (Figure 2)] and type 2 [supersequence (Figure 3)] deposition); the top of the ordinal transgression *preceding* the highstand (Systems Tract, I or II [Posamentier and Vail, 1988, pp. 126, 128; figs. 1, 5) (see Figures 3, 1) and general regression.

Van Wagoner et al. (1988, p. 44) described the *downlap surface* as a marine-flooding surface onto which the toes of prograding clinoforms in the overlying highstand systems tract downlap. This surface marks the change from a retrogradational (moderate terrigenous influx: the backward [landward] movement or retreat [advance] of a shoreline or a coastline by wave erosion; retrogradation produces a temporal, slight steepening of the areal coastal beach section at the high-energy zone) to an aggradational (high terrigenous influx) parasequence set and is the surface of maximum flooding.

Unconformity: a surface separating younger from older strata, along which there is evidence of subaerial erosional truncation (and, in some areas, correlative submarine erosion) or subaerial exposure, with a significant hiatus indicated. (Posamentier et al., 1988, p. 110.)

Accommodation: the space made available for potential sediment accumulation. (Jervey, 1988.)

Endnotes

1. *Thermo-tectonics:* the vertical movement of basement rocks—the rigid crust, especially subsea basaltic plates—in response to transfer of magma from the asthenosphere upward to the ductile crust (Ewing, 1965; King, 1983, p. 29; figure 13). King (p. 29) wrote: ". . . the tectonics involved are vertical in expression and are activated by the accumulation of levitated ([high pressure, compressed hydrogen] gas-impregnated) upper mantle rock that rises and is injected, probably up a preexisting megashear, into the lower crust."
2. Carey (1976, p. 324) portrayed the solar system as vibrant with resonances, tones, and overtones,

> . . . like a random tray of sand…perturbed by vibrators…long enough to develop complex systematic patterns. As every grain of sand has jostled its position in relation to its neighbors, so every body in the solar system has varied all elements of its motion in response to the perturbations of its fellows. The dominant directors have been the sun-jupiter binary, and if any such a binary started with a random field of associated bodies, reiterative perturbations through the aeons would have produced a resonant system such as we see, in the plane of the dominant binary. But every particle in the system has contributed its tittle in determining the motions of all the others.
>
> These conclusions have great significance in the palaeotectonics of the earth [Psalm 82:5c]. It is false to assume that any of the elements of motion of any of the bodies have been constant [the *variability* of uniformity: ". . . few of the fundamental 'constants' are indeed constant . . ." (p. 119), e.g. "The nexus of ephemeris time and atomic time, equated by definition today, may have converged thither during the past, and may diverge thence in the future" (Ibid.)]. All have been modulated by the symphony of the whole. Variation of the gravational constant, G, adds another factor to the variation.…The mathematically intractable stabilities and instabilities of the multi-body gravational problem pollutes with uncertainty retrospection of the history of the solar system. Rare unstable configurations seem probable, analogus to systematic instabilities in radioactive nuclei. Such an unstable configuration would cause significant regrouping. . . .
>
> Such astronomic spasms may be the answer to some of our present enigmas. . . .

3. In an impassioned plea, Sloss (1988) himself stated: "The principles and practice of sequence stratigraphy are of ancient heritage" (p. 1661). However, Sloss (p. 1662) cites his own work (Sloss, Krumbein, and Dapples, [1948] 1949) ". . . as the first explicit reference to the sequence concept. . . ." Other significant works include: Sloss (1950), Krumbein and Sloss (1951), and Sloss [1959] (1963). Sloss (1988, p. 1663) characterized his own thoughts presented to the Pittsburgh meeting of the Geological Society of America, 1959, and later published as "Sequences in the Cratonic Interior of North America" (1963) (*Geological Society of America, Bulletin*. 74, pp. 93-113) as—the ". . . paper that most workers tend to quote as *the* earliest exposition of the modern-era sequence concept."
4. Criticism of sequence stratigraphic concepts originated with Brown and Fisher (1980), Miall (1986; 1991; 1992), Summerhayes (1986), Hubbard (1988), and Kendall and Lerche (1988). Compelling arguments concerning difficulty in proving glacial eustasy remain. Indeed, glacial eustasy may not play a significant role in overall sea-level change; it is not possible to consistently employ glacial-interglacial activity beyond the Eocene (Paleogene); only since the Miocene (Neogene) is direct evidence seen for significant climate change approaching regularity. Nevertheless, the program of sea-level change proposed by the Exxon group does not depend entirely or even significantly on glacial eustasy or climatic change; other probable causes exist for *first*- through *sixth*-order cycles, these include: (1) breakup and rebounding of the continents, (2) intermittent, rapid volume changes in world-wide ocean basalt beds induced by changing spread rates at mid-Oceanic ridges, (3) short-term (extraordinarily rapid) volume changes at mid-oceanic ridges, (4) climatic changes due to subsea volcanic expulsion of smoking aerosols with resultant glacial-interglacial episodes. Reactionist statements abound; e.g., Miall (1992, p. 790)—a strict uniformitarian and perpetual critic of sequence stratigraphy—stated that "the existing Exxon cycle chart should be abandoned—it is too flawed to be fixed…we should start again, by building a framework of independent sequence stratotypes…without preconceptions as to the results"; Walker (1990, p. 780), an advocate of allostratigraphy (see Appendix I), stated that "sequence stratigraphy as presented by the Exxon group…is a theoretical concept that was introduced without specific worked-out examples" and that the current stratigraphic schemes of Vail and his colleagues (the Exxon group) and W. E. Galloway (Bureau of Economic Geology, Austin, Texas: genetic stratigraphic sequences: an emphasis upon flooding surfaces) (see Appendix I) are "largely conceptual, with little or no consideration of scale of application, or actual geological examples" (see Weimer and Posamentier, 1994, p. 10). Walker (1990) and R. J. Weimer (1992), 1991-1992 president of the American Association of Petroleum Geologists, expressed concern that sequence stratigraphic concepts are accurate only when applied to passive margins like the Gulf coast of the southern United States. Weimer and Posamentier (1994, p. 8) reported that some of the early critics of the Exxon approach (e.g., Brown and Fisher, 1980; Summerhayes, 1986) have now grasped the power and significance of the approach, having applied the Exxon method—emphasizing erosional unconformities (see Appendix I)—to their work.

5. In the broader sequence curve (Systems tracts)—a *type 1* depositional sequence (incorporating a complete program of transgression and regression [see Fig. 2A; B] *or,* as in the case of lower to middle Miocene and the late Miocene to late Pliocene, *ordinal transgression* and *ordinal regression* [a *type 2* depositional sequence]) (Fig. 3)—Vail and Hardenbol's (1979, p. 72) analysis includes the definitions:

   Highstand: "the interval of time when sea level is above the shelf edge . . ."

   Lowstand: "the interval of time when sea level is below the shelf edge."
6. Sequence stratigraphy portends to replace the uniformitarian framework or traditional *formation-scale* timeframe of proper geographic-geological names (standard chronostratigraphy: eons, eras, periods, and epochs) with a more impersonal scale of uppercase letters and numbers (megacycles, supercycle sets, and supercycles) and numbers with decimals (*third*-order cycles). The replacement-scale is known as *sequence chronostratigraphy*. This more dynamic and flexible timescale is already appearing in the professional literature. Versions of a revised standard—the Vail sequence chronostratigraphy chart (Wilgus et al., 1988, pl.: Mesozoic - Cenozoic Cycle Chart [finalized in 1986])—are designated by a floating appropriation of numbers, decimals and uppercase letters (e.g., version 3.1A [January 1987]) (Haq et al., 1988, pp. 96-97; Figure 15).
7. The statistical record of eustatic change—based upon more than 100 years of field work supported by 60 years of seismic stratigraphic methods and now interpreted by the new discipline of sequence stratigraphy—was portrayed by Wilgus et al. (1988, pl.: Mesozoic - Cenozoic Cycle Chart [finalized in 1986]) as short-term *third*-order cycles superimposed upon and subsidiary to long-term *second*-order cycles (*type 2* depositional sequence: supersequence) (see Figure 3).
8. It was Thomas Kuhn (1962, 1970, p. 92) who defined revolutions or turning points in scientific knowledge as "those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one."
9. Gould (1967, p. 51), for personal amusement, borrowed the idea of a title for his paper from James Thurber and E, B. White's 1929 impertinent locution, "Is Sex Necessary?" (New York: Harper, 197 pp.):

   > In titling that article "Is Uniformitarianism Necessary?" I did not suggest, as some critics have stated (Longwell, 1965 and Hay, 1967 in the *Journal of Geological Education*) that the *concept* of methodological uniformitarianism is unnecessary (since it is only the *term* that I wish to abandon), but rather that it is every bit as inevitable as the phenomenon which provided, via the analysis of James Thurber and E. B. White, a source for [their] title (Thurber and White, 1929).

   Yet, Gould (1967, p. 51; 1970) admits that uniformitarianism should be "dismissed as untrue"—at least *substantive uniformitarianism* (consistency of material conditions or rates of processes). Elsewhere, *methodological uniformitarianism* invokes "a set of two procedural *assumptions…*basic to historical inquiry in any empirical science" (italics mine): (1) "natural law's are constant in space and time," (i.e., exhaltation of unimaginative reason shall be raised to the place of scientific *law*) and (2) "that no hypothetical unknown processes be invoked if observed historical results can be explained by presently observable processes" (i.e., the philosophy of naturalism shall reign supreme despite common sense).

   Nevertheless, Gould (1967, p. 51; 1970) regards the philosophy of uniformitarianism as every bit as inevitable as sex! This, despite the fact that ". . . It leads students to the false idea that our science [humanist geology] possesses a unique philosophical tool [all humanistic disciplines use it] and thus obscures the relationship of geology to other empirical sciences."

   Gould is often too smart for his own good. He is too willing to debase the "secure" sandy foundations of his own world-life view. The Christian creationist ought to take full advantage of this author's no doubt heavily pondered philosophic caprice. Gould, writing from the perspective of an uncertain agnosticism concerning uniformitarianism (or almost so), provides the Christian creationist with untold hours of entertainment *and* inspiration. We could have no greater secular friend!
10. Indeed, there would be no need to restate uniformitarianism as a philosophic dichotomy except to address apologetically the critics of quietism, chief among them for this period—Henry M. Morris. Had Gould been reading Morris (1946; 1951; 1957; 1963; 1964a; 1964b) or Whitcomb and Morris (1961, 1973)? Perhaps Christian creationists are more influential than the secularists are willing to admit.
11. Francis A. Schaeffer (1968, 1976, p. 178) defined the *existential* as "relating to and dealing with moment by moment human existence." Essentially, it is "empirical reality as opposed to mere theory."
12. In perhaps the most pivotal work in the modern study of the earth—*Principles of Geology* (3 volumes, 1830-1833)—Charles Lyell emphasized the uniformity of natural causes in a closed system (time invariance) in the field of geology. This idea, borrowed from John Playfair (1748-1819)—*Illustrations of the Huttonian Theory* (1802)—and James Hutton (1726-1797)—*Theory of the Earth with Proofs and Illustrations* (2 volumes, 1795)—suggested there are no forces in the past except those that are presently active.

   Stephen Jay Gould, in *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time* (1987a, pp. 104-105), has written that the first volume of Lyell's *Principles of Geology* (1830-1833) begins with five chapters on the history of geology and its lessons for establishing a proper approach to a modern study of the earth. Roughly characterized, Lyell holds that geological truth must be unraveled by strict adherence to a methodology that he did not name, but that soon received the cumbersome designation of "uniformitarianism" (in a review by William Whewell, written in 1832). Lyell captured the essence of uniformity in the subtitle to his treatise: "An Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes Now in Operation."

   Henry M. Morris—in a critical examination of the historic and contemporary roots of uniformitarian-evolutionistic philosophy and its destructive influence in all fields of study and in all areas of human life (1989, 1990, pp. 25-27)—offered that the famous Lyellian principle of *uniformitarianism* ("the present is key to the past") is nothing more than the old philosophy of naturalism, as applied to the study of earth history. Uniformitarianism by itself, however, does not provide a history, but only the naturalistic framework (time invariance) within which that history is assumed to have taken place. Thus, naturalistic evolution, or evolutionary uniformitarianism, provides the basic interpretive framework for the earth sciences as well as the life sciences. Without the assumption of evolution, modern geology is without any objective basis for the whole system of geological ages.
13. Francis A. Schaeffer (1968, 1977, pp. 9-18) documented the origin of the *nature-vs.-grace problem*. Grasp of Schaeffer's concept—the *existential dichotomy*—first portrayed with the nature-vs.-grace problem introduced by Thomas Aquinas (1225-1274) is fundamental to understanding the modern mind, modernism (humanism) in general, and the failure of modern humanist theory. The despair evident in post-modernist worldviews is symptomatic of the collapse of reason and science as final descriptors of human content, meaning, or experience. Post-modernism stresses the need to make vital life-fulfilling or life-saving choices by using unlimited freedom in a contingent and apparently purposeless world: an existential world without a rational or scientific base for morals, ethics, or standards. Personal (particular) or social (universal) convenience is the final standard. Elsewhere, Schaeffer (1976, pp. 55, 52) wrote:

   > This problem is often spoken of as the nature-versus-grace problem. Beginning with man alone and only the individual things in the world (the particulars), the problem is how to find any ultimate and adequate meaning for the individual things. The most important individual thing for man is man himself Without some ultimate meaning for a person (for me, an individual), what is the use of living and what will be the basis for morals, values, and law? If one starts from

individual acts rather than with an absolute, what gives any real certainty concerning what is right and what is wrong about an individual action? The nature-and grace tension or problem can be pictured like this:

> ***Grace, the higher:*** *God the Creator;* heaven and heavenly things; the unseen and its influence on the earth; *unity,* or universals or absolutes which give existence and morals meaning.
>
> ***Nature, the lower:*** *the created;* earth and earthly things; the visible and what happens normally in the cause-and-effect universe; what man as man does on the earth; *diversity,* or individual things, the particulars, or the individual acts of man.

Beginning from man alone, Renaissance humanism—and humanism [modernism] ever since—has found no way to arrive at universals or absolutes which give meaning to existence and morals.…Thomas Aquinas (l225-l274] brought this Aristotelian emphasis on individual things—the particulars—into the philosophy of the late Middle Ages, and this set the stage for the humanistic elements of the Renaissance and the basic problem they created.

In his important book *Escape from Reason* (1968,1977, p. 13), Schaeffer outlined the significance of the nature-vs.-grace problem and its continuance with the humanistic (modernist) philosophers:

> The vital principle to notice is that, as nature was made autonomous, nature began to ‘eat up’ grace. Through the Renaissance, from the time of Dante to Michelangelo, nature became gradually more totally autonomous. It was set free from God as the humanistic philosophers began to operate ever more freely. By the time the Renaissance reached its climax, nature had eaten up grace.

14. The Hebrew word *har* is a short translation of the longer *hârâr* meaning, to *loom* up—as a *mountain,* hill, or mount; essentially, *har* implies a *mountain* or mount, or *range* of hills or the hill country proper.

Whitcomb and Morris (1961, 1973, p.1) wrote:

> One of the most important Biblical arguments for a universal Flood is the statement of Genesis 7:19-20:
>
> > And the waters prevailed exceedingly upon the earth; and all the high mountains that *were* under the whole heaven were covered. Fifteen cubits upward did the waters prevail; and the mountains were covered.

In *A Commentary: Critical, Experimental, and Practical on the Old and New Testaments* (Jamieson, Fausset, and Brown, 1864-1870; 1946, v. 1, p. 97; Gen. 7:19-20), Robert Jamieson (1802-1880) explained: estimating the Biblical cubit at 18 inches, then it is possible to conclude that Flood waters lapped 23 feet above the peaks of the highest mountain range. This accurate measurement of the depth by a sounding plum, indicates that not only were careful observations made, but a record was kept by Noah and his family (observational recordation is a fundamental of “science”). Jamieson (Ibid.) wrote:

> But according to *Delitzsch,* “this, statement, that the water rose fifteen cubits above the mountains, is probably founded upon the fact that the ark drew fifteen feet of water, and that when the waters subsided, it rested on the mountains of Ararat [eastern Turkey], from which the conclusion would very naturally be drawn as to the greatest height attained.”

Whitcomb and Morris (1961, 1973, pp. 1-2) suggested that one need not be a professional scientist to realize the tremendous implications of the Biblical statement; if only one (to say nothing of all) of the high mountains were covered with water, the Flood should indeed be considered absolutely universal: the present Mt. Ararat (Büyük Agri), on or near which the Ark was said to have grounded is 16,945 feet above present sea level. However, it is not necessary to assume that ante- or immediately post-Diluvian mountains were this high.

Referring to the geological mechanism of isostasy (Pratt vs. Airy hypothesis) Whitcomb and Morris (1961, 1973, p. 268) wrote:

> Presumably before the Flood, the earth’s crust was in a state of general equilibrium, although the great pressures of the fluids locked within the “great deep” made it a *precarious* state of equilibrium. The principle of isostasy (“equal weights”) requires that, at some datum level deep in the crust, pressures due to superincumbent materials be everywhere constant in order for crustal equilibrium to be maintained. Thus, regions of high topography must be regions of low density and vice versa [Pratt hypothesis]. Probably there were no very substantial regional differences in land densities [Airy hypothesis] before the Flood, and correspondingly, no very large regional differences in elevation. Mountains were relatively low and ocean beds relatively shallow as compared with present conditions.

Indeed, on the early pre-Flood Earth, the great Cordilleran orogen of the Tethys (an equatorial geosyncline expressed in *three* fold-phases) and the Tethyan orogen proper (an intracontinental, globe-girdling deformation of original basement rock) were but a zone of high hills dividing the single megacontinent in half (the Earth’s great orogens were each initiated as equatorial rifts). The conjugates to the Tethyan orogen—the Caledonian-Appalachian-Tasmanide tectogenesis (now dispersed on four continents)—developed as a predecessory series of low hills. A good contrast between these two related orogenic systems—*low* and *high* hills—is, today, viewed *in* and *near* the old Canal Zone of Panama, Central America (see Carey, 1988, p. 310). It is here that each of Earth’s original topographic highs—long since subjected to continued uplift—intersect. It is significant that the highest peaks immediately adjacent to the old Canal Zone—Cordillera de San Blas—are but a little over 3,000 feet above sea level.

15. Among the most important offerings of the sequence stratigraphic approach is the development of the study of geology in scales—*macro*- *meso*- and *microscale* (see Posamentier, Allen, and James, 1992); a graphical portrayal would include cycles within cycles—“. . . a wheel in the middle of a wheel” (Ezekiel 1:16; 10:10 NKJV) or wheels within a wheel, or largest “cycle” to smallest cycle—

*macro*scale:
  supermegasequence (proposed)
    megasequence.
      supersequence (*ordinal transgression – regression*)

*meso*scale:
  sequence (*cardinal ascendent – descendent*); (*third*-order scale)
    parasequence set
      parasequence
        bedset
          bed —“local” geologic column
            lamina set

*micro*scale:
  lamina

Significant, here, is the discussion of sequence stratigraphic principles applied to other settings besides marine and at all spatial and temporal scales.

16. Francis A. Schaeffer (1968, 1976, pp. 179, 178) defined *rationalism* and therefore the *rationalist* as synonymous with humanism:

> There are two meanings: (1) Any philosophy or system of thought that begins with man alone, in order to try to find a unified meaning to life; (2) That part of humanistic thinking in the above wider sense that stresses the hope of an optimistic future for mankind.

17. Schaeffer (1968, 1976, p. 178) defined epistemology as: “That part of philosophy concerned with the theory of knowledge, its nature, limits and validity.” In the popular book He is There and He is Not Silent (1972, 1976. pp. 37, x), Schaeffer, wrote:

> Epistemology means the theory of the method or grounds of knowledge—the theory of knowledge, or how we know, or how we know we know. Epistemology is the central problem.…Unless our epistemology is right, everything is going to be wrong.

Appendix I:

Sequence Stratigraphy: Various Schools

Many different concepts arid definitions exist for what constitutes sequence stratigraphy, including genetic stratigraphic sequences (Galloway, 1989a; 1989b), depositional episodes (Frazier, 1974), allostratigraphy (North American Commission on Stratigraphic Nomenclature, 1983; Walker, 1990), and transgressive-regressive cycles (Embry, 1990), to name a few. These stratigraphic concepts and associated nomenclature have been merged in the literature, causing confusion among workers, especially in their application to exploration and field development problems. For the purpose of clarity and simplicity, the term "sequence stratigraphy" will be used in the sense of Posamentier and Vail (1988) and Van Wagoner et al. (1990). (Posamentier and Weimer, 1993, p. 731; n. 4.) (Italics mine.)

School 1: Classical Sequence Stratigraphy:

The Exxon Approach: an emphasis upon erosional unconformities:

Posamentier, H. W. and Vail, P. R. 1988. Eustatic controls on clastic deposition II—sequence and systems tract models. In Wilgus, C. K., Hastings, B. S., Posamentier, H., Van Wagoner, J., Ross, C. A., and Kendall, C. G. St. C. (editors). Sea-Level Changes: an Integrated Approach. Soc. Econ. Paleontol. Mineral. Tulsa, Oklahoma. Special Publication No. 42, pp. 125-154.

Van Wagoner, J. C., Mitchum, R. M., Jr., Campion, K. M., and Rahmanian, V. D. 1990. Siliciclastic sequence stratigraphy in well logs, core, and outcrops: concepts for high-resolution correlation of time and facies. Am. Assoc. of Petroleum Geologists Methods in Exploration Series 7, 55 p.

School 2: The Bureau of Economic Geology, Austin, Texas:

Genetic Stratigraphic Sequences: an emphasis upon flooding surface:

Galloway, W. E. 1989a. Genetic stratigraphic sequences in basin analysis I: architecture and genesis of flooding-surface-bounded depositional units. *Am. Assoc. of Petroleum Geologists Bull.* 73(2):125-142.

________. 1989b. Genetic stratigraphic sequences in basin analysis II: application to northwest Gulf of Mexico Cenozoic basin. *Am. Asso. of Petroleum Geologists Bull.* 73(2):143-154.

Depositional Episodes:

Frazier, D. E. 1974. Depositional episodes: their relationship to the Quaternary stratigraphic framework in the northwestern portion of the Gulf basin. The University of Texas at Austin. Bureau of Economic Geology. Geological Circular 74-1, 28 p.

School 3: Allostratigraphy:

Allostratigraphic unit: a mappable body of sediments bounded by discontinuities:

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Appendix II:

Present-Day Sea Level:

Datum for Determining Eustatic[1] Change

Haq et al. (1987, p. 1158; fig. 2; 1988, pp. 94-100; figs. 14-17) in determining sea-level change used as a datum present-day sea level (see Figure 3 [Tertiary Period]) respective of the land surface. Allowing for modern (Holocene) fluctuations as well as tidal effects, this is an acceptable starting place in developing a program (the sequence stratigraphic approach) of reconstruction of sea-level changes.

The record for the Cenozoic is developed first (Figure 3). The record is then researched farther back into geologic history (Figure 2). Essentially, the program (with modifications) offers a tool for characterizing various components of rising and falling in the sea-level curve (the Vail curve) and therefore transgressive-regressive depositional cycles: all cycles (*zero*-order [the Genesis Flood] [see Appendix III] to *fourth*-and higher orders) despite size or effect are here characterized by a geologic fundamental: varying depositional environments (not necessarily varying paleoecologic zones) develop distinct scalar (quantitative) or modular (qualitative) sequence lithofacies (rock suites); these lithofacies—

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[1] *Eustasy* was defined by Mitchum (1977, p. 206) as a *global* or *relative* change in sea level (an apparent rise or fall of ocean-water level—on a local, regional, or global scale—respective of the land surface) produced by either a change in the volume of sea water (additions of water to, or removal of water from, the continental ice caps) or a vacillation in the surface area of the ocean basins, or both.

parasequence, sequence, supersequence, megasequence, supermegasequence—are evidenced (easily referenced) in the rock record (Figure 1).

Some scientists mistakenly assume that Burton, Kendall, and Lerche (1987) condemned the idea of eustatic sea-level charts because *no official datum exists in the rock record from which to measure eustatic sea-level change;* however, Burton, Kendall, and Lerche only stated that "an accurate eustatic sea-level variation chart…cannot be made," meaning that—"absolute values remain elusive" (p. 265); nevertheless, they concluded that:

> …when *relative* sea-level charts (combining tectonic and eustatic effects) are tied to wells [providing generalized stratigraphic control through reflection or refraction data and well cores], it is still possible to project sedimentary sequences related to the relative sea-level events across a basin on seismic cross-sections after the manner of Vail et al. (1977) [1977c] and Hallam (1981).

For this reason, Kendall and Lerche (1988) were chosen by the Vail proponents to write the introduction to the premier work on sequence stratigraphy—*Sea Level Changes: an Integrated Approach* (Wilgus et al., 1988). This important work introduced the Mesozoic - Cenozoic Cycle Chart (pl. l)—the final version (1986) of the original Vail curve (Vail et al., 1977b, p. 84; fig. 1 [see Figure 2]) depicting global changes or cycles of sea level—prerequisite to the additional refinements, presented as *eustatic* curves or *global* changes in sea level, of Haq et al. (1987, p. 1158; fig. 2; 1988, pp. 94-100; figs. 14-17) (see Figure 3 [Tertiary Period]).

Second, Burton, Kendall, and Lerche (1987, p. 237) defined *eustasy* as:

> …a change in elevation in sea level on a worldwide basis relative to the stationary datum at the center of the earth.

This definition is remarkably similar to one offered for the expanding earth (Egyed, 1956a; 1956b; 1963; Carey, [1956] 1958; 1976; King, 1983), i.e. the diameter of the earth has grown progressively larger through geologic time, perhaps by as much as 33 percent; the overall increase in diameter is attributable to changes in atomic and molecular structure (phase changes) in the core and lower mantle; the resultant expansion did not add actual mass; instead of lateral (or horizontal) movements on the surface of a sphere (continental drift or plate tectonics), earth expansion implies vertical (centrifugal) levity *within* the sphere; the stationary center of the earth's core is used as a datum for change (see Irving, 1969, p. 111; 1964; Van Andel and Hospers, 1969).

Appendix III:

Creationist Sequence Stratigraphy: the *Zero*-Order Cycle

In an experimental program of creationist sequence stratigraphy, the *zero*-order cycle is the starting point for the investigation of the rock-stratigraphic record. This is the lowest frequency sea-level cycle or *order* subject to testing (verifiability - falsifiability) through successive evaluation of each sub-order sea-level cycle.

Each sub-order sea-level cycle—*first*- through *sixth*-order and below (high frequency range: daily and annual cycles) is evaluated on its own merits without considering any previous sea-level cycle. However, *there is no difference* as the concept of scale is purely applied.

Generally, the *zero*-order cycle is a statement that any particularized cycle or *type* depositional sequence has a specific value, i.e. a specific verifiable - falsifiable reckoning on a graduated scale of events.[1] There are four types of depositional sequences:

(proposed) **type 0** depositional sequence
(*supermegasequence*):
zero-order cycle: the Genesis Flood
type 1 depositional sequence\
(megasequence):
first-order cycles: the Vail "long-term" line (Haq et al., 1988, p. 95; fig. 14)
type 2 depositional sequence
(supersequence):
second-order cycles:
ordinal transgression - ordinal regression
(proposed) **type 3** depositional sequence (sequence):
third-order cycles:
cardinal ascendent - cardinal descendent

If a sea-level cycle has a different value, either scalar (quantitative) or modular (qualitative), it has that specific value in relation to the *zero*-order cycle.

The *zero*-order cycle is an existing arithmetical potential (denoting the absence of exponents) placed as the lowest verifiable order expressive of the Phanerozoic rock record (generally sediments resting atop the Cambrian basement) and reckoning all value of successive, naturalistically occurring cycles simultaneously from within *and* outside itself.

The *zero*-order cycle is a non-naturalistic (denoting the absence of the ordinarily uniform or naturally occurring), allo-superior, unique *event* (moment) with an obscurely apparent absence of quality (modulation)[2] if time—in part or in whole (synecdoche)—is the only consideration. In this respect, the *zero*-order cycle is conspicuously absent, null, or at least elusively missed. If time, subject neither to varying quantitative scales or varying qualitative models,[3] is the emphasis, the *zero*-order cycle (the Genesis Flood) is easily rejected as worthless or of no account.

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[1] *Processes* are open to both scalar (quantitative) or modular (qualitative) influences; *time* is not. Time is open neither to scalar or vector quantities or qualities. Time is neither momentum or energy. Thus, the time-independence of creationist sequence stratigraphy.

[2] A graphical variation in the amplitude of a source frequency or phase carrier wave (supermegasequence) when compared to other more immediate signals (megasequence, supersequence, sequence, parasequence set, parasequence, bedset, bed, lamina set, lamina).

The rejection of the *zero*-order cycle (the Genesis Flood) implies the exclusive acceptance of naturalistically occurring long-term, ordinal, and cardinal cycles. But, these suborder cycles have no inherent meaning outside of themselves if the zero-position is rejected.

What we see in the rock record—the evidence of oscillation of sequences—may be so mixed with the very real component of the *supermegasequence* signal that genuine, insightful perception may prove obscure or even impossible. The problem is an epistemological one.

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[3] Time is time. Time comparisons to time or varying descriptions of time exist; but in a real world (not subjected to theoretical, fanciful distortions), time is time; i.e., time proceeds with regularity (uniformity) not open (naturalistically) to ascension or descension, acceleration or deceleration. Time is neither scalar (magnitude without direction) or vector (direction and magnitude). Time is *zero*-order: i.e., any particular moment has specific value outside of or beyond scalar (quantitative) or modular (qualitative) values; time derives from time, time reverts to time; all things were created from the moment, all things revert to the moment: this is otherwise known as Perfect Cosmological Principle (Colossians 1: 16-17).

Second, despite Posamentier, Allen, and James' (1992, p. 310) ingenious attempt at describing high resolution sequence stratigraphy at the East Coulee Delta (a naturally occurring scale-model delta), Alberta, Canada, temporal (time) scales *do not* exist. Spatial scales *are* dimensional. A variable, oscillating scale for time is a violation of methodological uniformity. *Process* might be subject to *rate* (quantitative or qualitative scales of varying degrees), however, time (limited to studies in the geologic record) is not.

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LETTERS TO THE EDITOR

Animal Death and the Curse

Did animals die before the curse of Genesis 3? This is the position of old earth creation, the gap theory, day age theory, and theistic evolution. However, Romans 5:12 declares that death first entered the world through sin. The usual explanation is that the death of Romans 5:2 describes physical or spiritual death of humans, not animals. However, this explanation is not convincing. Those who promote pre-curse animal death need to answer these nine questions:

1. Why is there no mention of animal death prior to the curse? To the contrary, Genesis 1:3 describes the Creation as very good. This would logically exclude survival of the fittest, suffering, and death in the animal world.

2. Does not Genesis 1:29-30 teach that people and animals had exclusively vegetarian diets at the Creation? This would exclude predation or any carnivore nature.

3. Does not the dominion mandate of Genesis 1:26 conflict with prior long ages of animal death and extinction?

4. The old earth view assumes many animal extinctions before man appeared, such as the dinosaurs. How then could Adam in Genesis 2:20 name all the created animals?

5. Why is animal death first implied only after the curse, in Genesis 3:21, when God provided skins to cover Adam and Eve?

6. Romans 8:20-22 teaches that the present world, including animals, is cursed and no longer in its original perfect state. If not death, what then is this additional curse upon animals?

7. Does not Ecclesiastes 3:19 teach the similarity of human and animal death, thus implying a common origin for death?

8. Isaiah 65:24-25 describes the millennial period when the wolf will lie with the lamb; they will "neither harm nor destroy." Does not this mean that animal death will be abolished, as originally intended?

9. If physical suffering and death existed in nature before the Fall, does not this make the Creator the author of evil?

The burden is upon long-age adherents to resolve these fundamental conflicts which they
promote.

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Home erectus — A Fabricated Class?

I have read Lubenow's letter (Lubenow, 1994) in which he states that "I believe that ALL of the *Homo erectus* material represents true humans."

May I be allowed to differ?

The classification was originally made to combine the Java man finds of Dubois and von Koenigswald (Bowden, 1988, p. 138f) and the Pekin man finds of Black, Teilhard de Chardin and Weidenreich (Bowden, 1988, p. 90). The "ape-men" fossil hunters also badly needed to link these two sites and appear to have fabricated this by "discovering" numerous teeth linking the sites in a cave: (Bowden, 1988, p. 152)

The Java man fossils consisted of a large ape type skull cap and a human leg bone. The Pekin man fossils were all apes.

These early members of this classification, therefore, were far from being fully human as Dr. Lubenow insists.

When true humans were found in the "Upper Cave," it took five years before they were reported, and then not in the journal that recorded all the main finds at the site. When ten human skeletons were found in 1939 at the site, the discovery was briefly blazed around the world, and then quick ly hushed up (Bowden, 1988, pp. 95-6). They would have totally destroyed the credibility of the Peking “man” ape skulls they had been claiming as half human for many years.

The classification of *Homo erectus* has been the major group that has been used by Paleoanthropologists to link man with apes. Some are ape fossils which have been claimed as nearing human (Pekin man), and others are human but linked with ape bones (Java man). The classification has been gradually enlarged to include true *Homo erectus* and other “bits and pieces” of bones that are too small to determine whether they are ape or human. If *Homo erectus* is human — which appears to be so, then it is only a variety of *Homo sapiens* as is Neanderthal man (Bowden;, 1980, 163f).

As an increasing proportion of a skeleton is discovered, it becomes clear whether it is human or ape. In examining fossil finds, two of the main features of human skulls is the rounded rear of the cranium and the vertical angle of the upper jaw beneath the nose. I would advocate the main discoveries of “ape-men” fossils be divided into human and ape as follows:

HUMAN.

Neanderthal man
Java man’s leg bone
Vertesszöllos skull fragment
Swanscombe skull pieces
1470 man
Piltdown skull
Pekin man Upper Cave skulls
Pekin man ten skeletons
Solo man
Dubois’ Wadjak skulls
Rhodesian man
Chellan man’s skull?
Homo erectus skulls where virtually complete
Laetolil footprints

APE

Homo habilus?
Pekin man skulls
Piltdown jaw (orang-utan)
All Australopithecines
Johansen’s “Lucy” skeleton
Von Koenigswald’s *Pithecanthropus* II, III, and IV (*robustus*)

I would conclude by warning that ALL classifications by paleoanthopologists are to be treated with more than just caution. They have been created for the sole purpose of forcing this badly needed link between man and apes.

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Reply to Malcolm Bowden’s Letter on the Taxonomy of Human Fossils

My good brother, Malcolm Bowden, and I are in agreement in several areas. I certainly agree with him that the human fossil classification system is an artificial one with an evolutionary bias. Unfortunately, since evolutionists control the human fossils—access to them, study of them, and terminology describing them—it is impossible to discuss these fossils without using that terminology and then attempting to give corrections.

We also agree that *Homo erectus* (which Bowden calls “true Homo erectus”) is fully human and that this taxon, together with the Neandertals, is a variety of *Homo sapiens*.

If I understand Bowden’s letter correctly, he takes issue with me regarding the Java Man skull originally called *Pithecanthropus* I; von Koenigswald’s *Pithecanthropus* II, IlI, and IV; and the Peking Man lower cave remains as all being included in the *Homo erectus* taxon, outlined by me in my book, *Bones of Contention: A Creationist Assessment of the Human Fossils.* Bowden feels that these fossils are not the remains of humans, but are instead the remains of apes.

There is no doubt that the evaluation of the human fossil material involves a degree of subjectivity. However, there is evidence that Bowden is in error in his assessment of these fossils as apes. They appear to be human for the following reasons:

1. Their cranial capacities. The cranial sizes of the fossils which Bowden calls apes are well within the modern human range.The capacity of *Pithecanthropus* I (the original Java Man) is 940 cc (Holloway,1981, p. 517). The average of the five lower cave Peking Man skulls that were complete enough for measurement is 1050 cc (Blumenberg, 1985, p. 270). The *Pithecanthropus* II, III, and IV skulls are poorly preserved and one is fragmentary. These are among the least important of the *Homo erectus* fossils, and because of their condition it is wise not to be dogmatic about them. In contrast to this, there is no evidence in the fossil record of large apes that have a cranial capacity within the range of modern humans. To use these fossils as such evidence is circular reasoning. The cranial capacities of all non-human primates—fossil and living—are far below the human range. My book

shows that we do not have to resort to calling these large-brained fossil individuals ìapesî in order to show that the concept of human evolution has been falsified.

2. Their morphology. The morphology of the *Pithecanthropus* fossils which Bowden rejects as human are very similar to the other *Pithecanthropus* (*Homo erectus*) fossils from Java (Thorn and Wolpoft, p. 347) which Bowden apparently accepts as human, and also similar to the African *Homo erectus* fossils which Bowden seems to accept as human. W. W. Howells states the the east African *Homo erectus* skull, KNM-ER 3733, which Bowden accepts as human, is surprisingly similar to the lower cave Peking Man skulls, which Bowden calls apes (Howells, 1980, p. 16).

3. Their similarity to Australian human fossils. Australia is thought to have been uninhabited until recently; and the Australian human fossil record reveals a tremendous disparity between "gracile" and "robust" groups of Australian ancestors. The "robust" fossil group shows great similarities to the Javanese *Homo erectus* fossils, some of which Bowden calls apes, whereas the "gracile" fossil group shows great similarities to the upper cave Peking Man fossils, which Bowden—and all others—recognize as human. However, no one has ever suggested that the "robust" Australian fossil group was not as fully human as the "gracile" group (Laitman, 1988, p. 67).

Without intending to do so, Bowden put an interpretation on one of my comments that I did not mean. There is a minimum of 361 fossil individuals categorized as *Homo erectus* by the evolutionist community, with the probability that the figure will go much higher when sites now being worked are evaluated. When I stated that all of the *Homo erectus* material represented true humans, I did not intend to exclude the possibility that there might be one or more fossil individuals that have been improperly allocated to that taxon. After all, the fossils and their allocation are controlled entirely by evolutionists. However, that is apparently the way Bowden took my statement. What I meant, in the context of the *CRSQ* letter Bowden referred to, was that the *Homo erectus* taxon is an improper taxon designed to serve evolution and that the fossil individuals that are legitimately allocated to it are true humans and should be classified as *Homo sapiens.* I have stated this many times in *Bones of Contention,* and it is obvious that Bowden agrees with that conclusion. Hence, in spite of our disagreement over the classification of a few fossils, our differences are not as great as would appear from Bowden's letter.

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The Rainbow and God's Covenant

If the assumption is made that bright sunshine existed before the Flood of Noah, people may well have seen the dispersive effects of light near waterfalls, i.e. a rainbow, even if it is assumed that no rain had fallen . . . But, if we take Genesis 9:13 literally, no rainbow was seen by man before God made His covenant. What is the answer? Are creationists who believe there was no rain (because of Genesis 2:5) correct? Or, is the "bow in the cloud" something other than a rainbow? Or, was there no bright sunshine until after the Flood?

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Editor's note: Dr. Larry Vardiman was kind enough to provide the following reply:

Clifford Lillo asks an interesting question about the "bow in the cloud" when he questions whether it was possible to see a rainbow near waterfalls before the Flood. I have considered numerous possible solutions over the years to questions like this. Of course, the first response could be that no waterfalls existed before the Flood. Genesis 2:6 says that a mist watered the ground which would probably not create large amounts of runoff or large rivers. It is also possible that the terrain was much smoother than today offering no place for waterfalls to occur.

Another response would be that God created rainbows after the Flood. Genesis 9:13 does not say that God created the rainbow after the Flood, but it is well within His power to do so. If He did so, such dispersive effects would not be evident around waterfalls before the Flood.

Another possible solution is that rainbows were present and visible before the Flood, but that God used them as a "token" of His covenant after the Flood. Genesis 9:12 says that God made a covenant at this time—He did not necessarily create the rainbow at this time.

However, my preferred interpretation is that rainbows were not seen before the Flood because the atmospheric conditions were not right to do so. If a vapor canopy existed with sufficient water content to absorb a high percentage of the light, the amount of sunlight reaching the earth from the horizons would not permit rainbows. Today rainbows exclusively occur near sunrise or sunset because of the geometry necessary for light to enter the raindrops and be reflected and refracted back to the observer. If sufficient light were only present from near the zenith before the Flood because of the presence of a canopy, rainbows would not be seen unless the observer were looking down from above on a cloud of rain drops. Since man only learned to fly in the twentieth century, he could not have been in the proper position to observe rainbows before the Flood.

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Quantum Physicists and Lawn Sprinklers

It is amazing sometimes how simple things can turn out to be so complicated. Who would have thought that the old fashioned lawn sprinkler offered much of a problem. It was stated very well in Parade Magazine of October 6 in the question and answer section by Marilyn Vos Savant. It concerned a conundrum that we have heard many times. But what a delightful surprise her bold conclusion! If it would have been some of us whose IQ is a little lower it might have gone unnoticed.

The question was: “If a lawn sprinkler with a rotating head were to suck water in instead of spewing it out — that is, if you were to put it underwater and apply suction to the other end of the hose — in which direction would the sprinkler heard turn: in the same or the opposite direction? And why?”

Marilyn Vos Savant replied: “This very phenomenon was the subject of much discussion and argument among nuclear physicists and quantum theorists until the American physicist Richard Feynman (who had waffled back and forth between educated guesses) decided to conduct an experiment and learn the result through direct observation. After getting everything set up and operating (although he decided to use compressed air in a glass bottle to force the sprinkler inside to send the water back out through the hose), he opened the valve a little farther and then a littler farther yet, and the whole thing exploded, spraying glass and water everywhere and making a big mess in the basement of Princeton’s new cyclotron lab, from which he was then exiled. Supposedly, the sprinkler didn’t turn at all, and it’s now accepted that, because the water enters all the holes from all directions at the same time, it applies no force. *Imagine how tough it’s going to be for these guys to learn whether the Big Bang theory is correct!”*

Could the reverse backward movement ever simulate the forward movement? There is no way to imitate the arching, jet stream of water spraying in the air going into reverse. That would be like putting Humpty Dumpty together again. The only way is to put the sprinkler into a tub or pool of water with a suction pump on the other end. But that does not simulate the normal action of the sprinkler.

If you put the sprinkler into a tub of water and adjust the pressure to be equal to the water in the tub it will cease to turn because the water no longer arches out in a thin stream but eases out equally around the holes in the arm. This is what it does when you reverse the process and suck it back.

Maybe the story of the sprinkler and the experiment is why some or us feel a little more comfortable in just recognizing that an Intelligent Being, made this world, who is “a little higher” than those who debated for so long on such a simple problem, and who had difficulty to simulate an appropriate experiment, and now have no hesitation in affirming that the Big Bang brought everything into being, and made the universe as we know it.

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Quote

Proverbs 3:19-20.

[19]By wisdom the Lord laid the
earth’s foundations,
by understanding He set the
heavens in place;
[20]by his knowledge the deeps were
divided,
and the clouds let drop the dew.

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ON TIME DILATION IN COSMOLOGY

JOHN BYL*

Received 14 August 1995; Revised 4 October 1996

Abstract

In recent years various authors have suggested that time dilation could solve the problem of seeing distant galaxies in a young universe. Time dilation which arises in both special and general relativity, could presumably slow earth clocks with respect to those on distant galaxies. This article examines how time dilation can arise within various relativistic cosmological models. It is found that in most cosmological models time dilation is either not significant or is in the wrong direction. Strong time dilation can occur in a static universe with pressure terms. However, in that case the predicted galactic red shifts would be much greater than those actually observed. It is concluded that the time dilation hypothesis thus faces a number of serious problems that must still be resolved.

1. Introduction

If the world is only a few thousand years old, how is it that we can see stars seemingly billions of light years away? Various possible solutions have been discussed in this journal, including mature creation (Akridge, 1979), curved space (Byl, 1988), a variable speed of light (Chaffin, 1990; Byl, 1990). In recent years several authors have proposed a new possibility: time dilation. In the theory of relativity the rate at which a clock ticks depends both on its motion and on the local gravitational field. Could it be that, in the past, time passed much more slowly on earth than in the distant parts of the galaxies, so that light from distant galaxies travelled billions of light years during, say, only a few earth years?

Although this view has received a considerable amount of publicity in the last few years, it has not yet been fully worked out. Both Roy Peacock (1990) and Gerald Schroeder (1990) appeal to time dilation to reconcile Genesis with modern cosmology. However, they provide no quantitative details and, as we shall see, their proposal is fatally flawed.

A more detailed scenario has been advanced by D. Russell Humphreys (1994). He has developed a rather elaborate cosmological model wherein the universe is considered to emerge from a "white hole" (i.e., the opposite of a collapse into a black hole). An earth-based observer, being near the center, would experience a greater gravitational field, resulting in a slower clock rate.

While this model looks promising, it is still incomplete and has not yet been proven able to provide sufficient time dilation. The scenario Humphreys describes is, as he himself acknowledges, highly speculative and is not yet backed up by definite quantitative calculations. All he offers is a possible outline of a solution. Hence, also this model, in its present unfinished state, does not convincingly solve the creationist problem.

The purpose of this paper is to examine the nature of time dilation. What conditions must a cosmological model satisfy for significant time dilation to occur? To this end various relativistic cosmological models will be examined. We shall see that in most cosmological models time dilation is not significant, nor in the right direction. Although it is possible to construct a static model where time dilation does seem to work as desired, this model unfortunately predicts large galactic red shifts, which are not observed.

2. Time Dilation In Special Relativity

In modern physics there are two causes of time dilation: (1) relative motion and (2) gravitational fields. In special relativity gravitational field's are not taken into account, so that time dilation due only to relative motion is considered. Two clocks will tick at different rates if they are moving relative to each other.

The light from distant galaxies is observed to be generally shifted towards the red end of the spectrum, the amount of red shift roughly increasing proportional to the distance of the galaxy. This is sometimes interpreted as a Doppler shift, the change in frequency due to the motion of an object away from us through space.

A frequency change implies a corresponding change in clock rates; the outward motion of a galaxy causes a slowing down of a clock on the galaxy. According to special relativity (Shadowitz, 1968, p. 40), a time interval Δt, as measured on a galaxy receding from us at a relative speed v, will correspond to an earth time interval

$$\Delta t_{earth} = \Delta t_{galaxy} \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}} \qquad (1)$$

As the galactic speed v, with respect to the earth, approaches the speed of light c, the galactic clock will appear to slow down to a full stop.

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Unfortunately, however, such time dilation is exactly opposite to what we need: The *earth* clock should be slowed down, not that of the distant galaxy. We need a long time interval on the distant galaxy during a short time interval on earth,. Equation (1), on the contrary, gives a long period of time on earth during a short period of time on the distant galaxy. Hence this type of time dilation will not help us. In fact, it makes the problem worse.

3. Time Dilation In General Relativity

Now examine time dilation in general relativity, where both motion and gravity effects are taken into account.

Peacock (1990, p. 111) and Schroeder (1990, p. 53) have both suggested that the six creation days are to be measared, not on earth, but on the divine clock. Due to motional and gravitational time dilation the divine clock could, presumably, be ticking much slower than an earth-based clock: Many billions of years could have passed in earth time during the corresponding six days of divine time.

But this will not do. The days of Genesis are clearly defined as periods of light and darkness as measured on the *earth.* The Genesis account refers to an earth-based clock, the same clock as that used by cosmologists.

In constructing various cosmological models we take note of the fact that, as seen from the earth, the uniyerse is roughly isotropic (i.e., it looks the same in all directions). Thus, assuming the universe to be spherically symmetric about the earth, we choose a reference frame with spherical coordinates, centred on the earth.

In standard cosmology the expansion of the universe is attributed, not to the motion of galaxies through space, but to the expansion of space itself, in which the galaxies are embedded. [Misner, Thorne, and Wheeler (1973, p. 777) refer to the expanding space as the "cosmological fluid".] The galaxies may have their own appreciable peculiar motions with respect to the local space of the universe. However, since we are in, terested primarily in general, averaged effects, we shall consider the galaxies to be locally at rest, any relative motion between them and the earth being due to the expansion of the universe as a whole.

According to general relativity, the basic equation governing the spacetime geometry is given by (Weinberg, 1972, p. 177)

$$d\tau^2 = g_{00}dt^2 - \frac{g_{rr}}{c^2}dr^2 - \frac{r^2}{c^2}(d\theta^2 + \sin^2\theta \; d\phi^2) \qquad (2)$$

This equation gives the change in τ, the "proper" time (i.e., the time as measured by the observer's clock) as the observer moves a small distance (measured in terms of changes in the radial coordinate r, and the angular coordinates θ and ϕ) during a small interval of t, the "coordinate" time (i.e., the ideal time in the absence of gravity). The terms g_{00} and g_{rr}, called "metric coefficients," measure the distortion due to gravity of time and space, respectively. For weak fields, where the distortions are small, both coefficients are close to 1.

Homogeneous Models

In standard big bang cosmology the earth is denied any special position; the universe is assumed to be isotropic from *any* position. This is known as the Cosmological Principle. It implies that the universe is everywhere the same (i.e., it is "homogeneous") and has no edges.

In a homogeneous universe the gravitational potential at any time is the same everywhere. Consequently, the metric coefficients will not vary with r and all clocks locally at rest will tick at the same rates. There is no gravitational time dilation in a homogeneous universe.

There will be some time dilation due to the expansion of the universe. As we shall see below, the expansion will generate a red shift that corresponds to a slowing down of clocks on distant galaxies by a fraction equal to the fractional change in the size of the universe during the transmission of light. The presently observed red shifts correspond to a time dilation effect that is both too small and in the wrong direction for the time dilation hypothesis which postulates that distant clocks should appear to be relatively faster, not slower.

Free-Fall Models

Perhaps non-homogeneous models are more conducive to time dilation. Following Humphreys (1994), we now consider a model where the universe is a sphere of radius R with uniform density ρ, centred about the earth. Recall that the galaxies are embedded in the universe: Their separations, measured as fractions of the radius of the universe, remain constant as the universe expands. It is thus most convenient to choose η as a "comoving" coordinate, which varies from 0, at the center, to 1 at the edge (i.e., η = r/R). Suppose that there is no pressure and the material is acted on by purely gravitational forces. Then the matter will be in "free-fall." If the material is given an initial outward velocity then we get Humphreys' white hole model, which is the reverse of a star collapsing into a black hole. Such a model has the following metric (Weinberg, 1972, pp. 344, 412; Humphreys, 1994, p. 91):

$$d\tau^2 = dt^2 - \frac{R^2(t)}{c^2}\left[\frac{d\eta^2}{1 - k\eta^2} + \eta^2(d\theta^2 + \sin^2\theta \; d\phi^2)\right] \qquad (3)$$

Here θ and ϕ denote the angular position and k is a constant depending on the curvature.

Note that for a galactic clock, embedded in the local space, the coordinates η, θ, and ϕ are constant. Hence $d\tau = dt$ (i.e., the proper time equals the coordinate time) and there is no gravitational time, dilation. All galactic clbcks tick at the same rate.

This result, which is similar to that for the homogeneous case, is not surprising, for equation (3) is identical to the Robertson-Walker metric for a homogeneous universe (Humphreys, p. 114; Weinberg, p. 344). In the free-fall model one can expect gravitational time dilation to be absent ($g_{00} = 1$) because the equivalence principle — the basis of general relativity — states that clocks in free-fall are not affected by gravity. It follows that this model yields the same time dilation effects as the previous case.

Why, then, does Humphreys get an apparent dilation? Humphreys follows the calculations of Weinberg (pp. 342-349) and Klein (1961), for the collapse of a star. Both of these authors arrive at equation (3) for comoving observers inside the star. On the other hand, for an observer at rest outside the star they obtain the static Schwarzschild metric, wherein time dilation does occur. It is only when one rewrites the interior coordinates in terms of the exterior, static Schwarzschild coordinates that the apparent time dilation arises, since then there is a singularity at the Schwarzschild radius. Such a transformation is needed to describe the collapse of the star in terms of a stationary human observer outside the star. However, when applied to Humphreys' model of the universe such a transformation serves no purpose, since all observers are, of course, inside the universe. In particular, as viewed by an earth-based observer, in terms of time measured by his earth clock, the metric of equation (3) is the pertinent one. Much the same point has been made by Conner and Page (1995) in their critique of this model.

This conclusion regarding the absence of time dilation in free-fall models is consistent with other papers on spherically symmetric non-homogeneous free-fall models. For example, G. C. Omer (1965) examined arbitrary spherically symmetric distributions (of which Humphreys' model is presumably a special case). Although such models clearly have a center and a gravitational potential gradient, Omer's metric in co-moving coordinates has no time dilation (i.e., the dt^2 term has a constant coefficient). Even more instructive is the work of Oscar Klein, whose (1961) analysis of a collapsing star forms a basis for Humphreys' calculations. In a later paper Klein (1971) himself studied a cosmological model identical to that of Humphreys: a bounded, finite universe of constant density which has a definite center and a gravtational potential gradient. There Klein did apply a continuity condition at the boundary to limit the maximum density of the university (he believed that the universe cannot collapse past the Schwarzschild radius). Yet he analyzed all observations using the interior metric (equation 3). For example, Klein finds that the frequency shift we should observe from a distant source within the universe depends only on the fractional change in the scale factor R during the light travel time. There is no ftirther change due to differences in gravitational potential, implying that there is no time dilation.

Static Models

Next consider some static models. Again, we assume the universe to be a sphere of uniform density ρ and radius R. To apply equation (2) we must first calculate the metric coefficients. A spherically symmetric mass distribution yields (Schutz, p. 259)

$$g_{rr} = \frac{1}{1-\frac{2Gm}{c^2 r}} \tag{4}$$

Here G is the gravitational constant and m is mass within a radius r, given by

$$m = \frac{4}{3}\pi\rho r^3 \tag{5}$$

The g_{00} term is more difficult to determine, as it depends also on the pressure. We first define a new variable Φ as follows

$$g_{00} = e^{2\Phi} \tag{6}$$

To keep the universe static in the gravitational field requires Φ to obey the equation (Schutz, 1990, p. 256)

$$(\rho+p)\frac{d\Phi}{dr} = -\frac{dp}{dr} \tag{7}$$

where p is the pressure. Furthermore, it follows (Schutz, p. 257; Misner, p. 608) that

$$\frac{d\Phi}{dr} = \frac{4\pi G(\rho + 3p)r}{3c^2 - 8\pi G\rho r^2} \tag{8}$$

The Static Zero Pressure Case

Consider first the static case with no pressure. This is, of course, physically unrealistic, since with no pressure to counterbalance gravity the universe cannot remain static but will collapse. However, this may serve to isolate the effect of the mass distribution alone on time dilation. If p = 0 and integrating the last equation, we find

$$\Phi = -\frac{1}{4}\ln\left(1 - \frac{8\pi G\rho r^2}{3c^2}\right) + K \tag{9}$$

where K is an integration constant. This yields

$$g_{00} = e^{2\Phi} = \frac{C}{\sqrt{1 - \frac{8\pi G\rho r^2}{3c^2}}} \tag{10}$$

where C = e^K. What is C? For r > R, it is found (Misner, et al., p. 607) that

$$g_{00} = 1 - \frac{2GM}{rc^2} \tag{11}$$

where M is the total mass of the universe, given by $(4/3)\pi\rho R^3$. At r = R equations (10) and (11) must match, giving

$$C = (1 - \frac{2GM}{Rc^2})^{\frac{3}{2}} \tag{12}$$

To slow the earth clock, equation (2) requires that g_{00} approach zero at the earth. According to equations (10) and (12), this can happen only when R approaches $2GM/c^2$. This critical value of R is known as the Schwarzschild radius, which we shall denote S. In terms of S we can rewrite g_{00} and g_{rr} as,follows

$$g_{00} = \frac{(1 - \frac{S}{R})^{\frac{3}{2}}}{\sqrt{1 - \frac{Sr^2}{R^3}}} \tag{13}$$

$$g_{rr} = \frac{1}{1 - \frac{Sr^2}{R^3}} \tag{14}$$

Note that for S/R << 1 we obtain the approximation:

$$g_{00} \cong 1 - \frac{3S}{2R}(1 - \frac{r^2}{3R^2}) \tag{15}$$

This corresponds to the static Newtonian potential, referred to by Humphreys (1994, p. 100).

Equation (13) indicates that, as R approaches S, the term g_{00} approaches zero for all values of r and all clocks will slow down. Will this fulfill the time dilation hypothesis?

The crucial question is how long will it take a photon to travel from a distant galaxy to the earth. To calculate this we return to equation (2). Since the earth is at the center of our coordinate system, the photon will be traveling along a radial line, so that dθ = dϕ = 0. Furthermore, since photons travel at the speed of light, equation (1) with v = c tells us that its clock is effectively stopped. Hence, for photons, dτ = 0, in equation (2). Solving equation (2) for dt/dr, we find that the photon travel time from r to 0 is thus given by

$$\Delta t = \int_0^r \frac{dt}{dr}\,dr = \frac{1}{c}\int_0^r \frac{\sqrt{g_{rr}(r)}}{\sqrt{g_{00}(r)}}\,dr \tag{16}$$

At the earth, which is fixed at r = 0 during this time, we have dr = dθ = dϕ = 0, and equation (2) gives the proper time interval elapsed as (see Misner, et al., p. 1107)

$$\Delta\tau = \sqrt{g_{00}(0)}\;\Delta t = \frac{\sqrt{g_{00}(0)}}{c}\int_0^r \frac{\sqrt{g_{rr}(r)}}{\sqrt{g_{00}(r)}}\,dr \tag{17}$$

In terms of the travel time in the absence of gravity (i.e., r/c), the fractional travel time, $\Delta\tau_{rel}$, is

$$\Delta\tau_{rel} = \frac{\sqrt{g_{00}(0)}}{r}\int_0^r \frac{\sqrt{g_{rr}(r)}}{\sqrt{g_{00}(r)}}\,dr \tag{18}$$

For this particular model, using the metric coefficients given by equations (13) and (14), the relative photon flight time is thus

$$\Delta\tau_{rel} = \frac{1}{r}\int_0^r \frac{1}{(1 - \frac{Sr^2}{R^3})^{\frac{1}{4}}}\,dr > 1 \tag{19}$$

If the photon comes from the edge of the universe (i.e., r = R) then this equation holds only for R > S. Since the integrand is always larger than 1, the integral is greater than r, so that $\Delta\tau_{rel} > 1$ (in fact, $\Delta\tau_{rel}$ increases from 1, at R = ∞ to 1.2, at R = S). Hence, also here, time dilation does not decrease the photon flight time.

For R < S this equation can still be used, but only for $r < (R^3/S)^{1/2}$. In this case, too, the relative flight time is greater than that in flat space. Thus this static model provides no time dilation for earth clocks.

A Static Model with Pressure

Finally, consider a static model with a pressure term. This is more realistic than the previous case, since the gravitational field is now somehow balanced. The case is then identical to that of a static star of uniform density, which is well-known (e.g., Schutz, p. 262; Weinberg, p. 331; Misner, et al., p. 610). The g_{rr} term is the same as before, but g_{00} is now given by

$$\sqrt{g_{00}} = \frac{3}{2}\sqrt{1 - \frac{S}{R}} - \frac{1}{2}\sqrt{1 - \frac{Sr^2}{R^3}} \tag{20}$$

Equation (18) yields a relative flight time of

$$\Delta\tau_{rel} = \frac{3\sqrt{1-\frac{S}{R}}-1}{r}\int_0^r \frac{dr}{\left[3\sqrt{1-\frac{S}{R}}-\sqrt{1-\frac{Sr^2}{R^3}}\right]\sqrt{1-\frac{Sr^2}{R^3}}} \qquad (21)$$

Note that there are two singularities, one at R = S and another when

$$3\sqrt{1-\frac{S}{R}} = \sqrt{1-\frac{Sr^2}{R^3}} \qquad (22)$$

This corresponds to R = 9S/8. To avoid both singularities, we constrain equation (21) to cases where R > 9S/8, or S/R < 8/9.

Now calculate the relative photon flight time from the edge of the universe (i.e., r = R) as a function of H, which is defined as H = 8/9 - S/R. Numerical integration of equation (21) shows that $\Delta\tau_{rel}$ approaches 0 as H approaches 0 (see Table I). In particular, for small values of H, $\Delta\tau_{rel}=5\sqrt{H}$.

Table 1. The relative photon travel time as a function of H=8/9-S/R.

H	0	.000	.001	.01	.1	.2	.4	.6	.8
$\Delta\tau_{rel}$	0	0.04	0.15	0.47	0.89	0.98	1.02	1.02	1.0

For example, a reduction of the flight time from, say 1 billion years to 1000 years (i.e., $\Delta\tau_{rel} = 10^{-6}$) requires R/S to be within about H = 0.2 x 10^{-12} of 9/8. Hence, if the universe is poised at precisely the proper radius, time dilation becomes highly significant.

What is the value of the critical radius R_{crit} = 9S/8? Humphreys (p. 105) estimates the mass of the universe, M, as about 3 x 10^{51} kg, based on a radius of 20 billion light years and a density of 10^{-28} kg/m^3. Taking c, the speed of light, as 3 x 10^8 m/s and one light year as 9.5 x 10^{15} m, we get R_{crit} = 8 x 10^8 light years. This is about 1/25th of the current assumed radius of the universe.

The time-dilation hypothesis thus requires the following scenario. The universe remained fixed at the critical radius for billions of years of coordinate time, which was just a few earth years. This was followed by a very rapid expansion from R_{crit} to almost the present radius (a factor of about 25) in at most a few thousand earth years. During this phase, the radius no longer being near the critical value, time dilation was greatly diminished: Earth time and coordinate time differed by at most a small percentage. If the universe were presently still in a state of such rapid expansion one would expect the brightness of the galaxies to fade appreciably over an interval of, say, 80 years. Since this has not been observed, one must postulate that, after a brief period of rapid expansion, the expansion rate was greatly reduced.

Note that the rapid expansion of the universe of a few billion lightyears during a few thousand years implies that the most distant galaxies receded from us at speeds greater than that of light. Such faster than light speeds do not contradict special relativity, for that limits speeds only with respect to the local space. Relativity theory places no constraint on the expansion rate of space itself. Faster than light stretching of space occurs also in inflationary cosmology (Linde, 1994).

4. Red Shifts

If significant time dilation has taken place then there should be further observational consequences. For example, since measurements of the frequency of light depend on the local clock rate, time dilation will alter the frequency, and thus also the wavelength of light. Let us calculate how the wavelength of light is altered in its journey from emission at observer 1 to reception by observer 2.

The wavelength of light can be altered by: (1) a Doppler effect due to motion of emitter or receiver relative to the local cosmological fluid, (2) local gravitational time dilation at the emitter or receiver, and (3) an expansion of the universe during transmission.

Assume, as before, that both observers are at rest with respect to the local matter of the universe. Local Doppler effects will thus be neglected. Further, in order to have strong time dilation effects, assume that at emission the universe was static (with pressure) and at the critical radius. After emission assume, for simplicity, that the universe reverted to the uniform density, free-fall case, so that the Robertson-Walker metric (i.e., equation (3)) applies.

Changes in the wavelength of light emitted from observer 1 and later received by observer 2 then depend on three steps:

(1) At emission, gravitational time dilation will cause the wavelength λ, as measured by observer 1 at $r = r_1$ to be stretched by a factor $g_{00}^{-1/2}(r_1)$, the ratio of the local proper time and the (flat) coordinate time.

(2) During transmission the wavelength will be affected by the expansion of the universe. If the density is to remain uniform all portions of the universe must expand at the same rate. The expansion of space stretches the wavelength by $R(t_2)/R(t_1)$, the fraction by which the universe has stretched during transmission. It is important to note that only the end values of R are important, not how R actually varied with time: it is not affected by rapid acceleration or deceleration (Misner, et al., p. 778; Weinberg, p. 416).

Humphreys (1994, p. 121) notes that the amount of red shift depends not on the expansion rate but only on the amount by which space has been stretched. He then asserts that it does not matter whether the expansion took place in

20 billion years or in six days. Yet one must be careful. Suppose that galaxy A is 1 million light years distant and galaxy B is 1 billion light years distant. For a slow, uniform expansion, the light we now receive from A will have been emitted much later than that of B. Hence the light from A will have undergone a much smaller stretching while in transit, corresponding to a smaller red shift. In this case z should be proportional to distance (i.e., the Hubble relation), as is observed. On the other hand, if the expansion occurs in a very rapid burst (as is postulated above) after the light from A was emitted, then the light from both A and B will be stretched by the same amount. In that case A and B (and other distant galaxies) will have the same red shift due to the expansion of space.

(3) At reception by another observer at r_2, another gravitational time dilation effect will change the wavelength by a factor $g_{00}^{1/2}(r_2)$, to bring it into observer 2's proper time.

Combining all three effects, we calculate z, the fractional change in wavelength to be

$$z = \frac{\lambda_2-\lambda_1}{\lambda_1} = \frac{\lambda_2}{\lambda_1} -1 = \frac{R(t_2)}{R(t_1)}\sqrt{\frac{g_{00}(r_2)}{g_{00}(r_1)}} -1 \qquad (23)$$

Let us now use this equation to calculate the red shift we should presently be observing for light from distant galaxies. If the light has been time-dilated it must have been emitted at the critical radius, so that $R(t_1) = 9S/8$ and, applying equation (20),

$$\sqrt{g_{00}(r_1)} = \frac{1-\sqrt{1-\dfrac{8r^2}{9R^2}}}{2} \qquad (24)$$

The critical radius was about 8 x 10^8 light years, 25 times smaller than the current estimated radius, yielding $R(t_2)/R(t_1) = 25$. All significantly time-dilated light now received from distant galaxies must have been emitted while (or possibly before) the universe was very near the critical radius. Hence, for all such distant galaxies, the stretching factor of 25 applies.

At reception at the earth, $r_2 = 0$. Assuming that the free-fall model now applies, $g_{00}(0)$ has a value of 1 [actually, this differs very little from that of the static model with pressure: equation (20) with R at the current radius yields a value of 0.95]. Equation (23) then gives

$$z = \frac{50}{1-\sqrt{1-\dfrac{8r^2}{9R^2}}} -1 \qquad (25)$$

Note that z varies from 74 for the furthest galaxies at r = R, to infinity for the nearest ones. For r << R we have z = $112/(r/R)^2$. This is quite different from the observed situation, where z is roughly proportional to r, increasing to a maximum of about 3.5 (see figure 1).

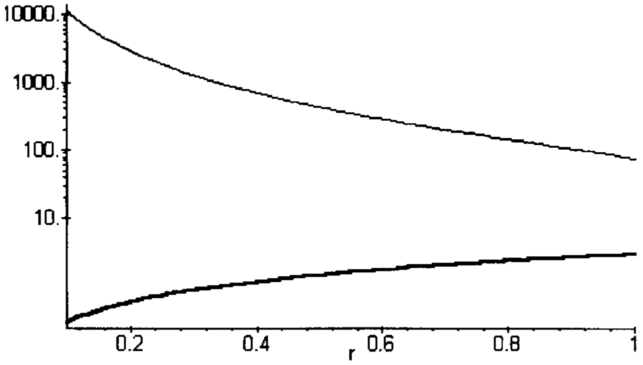

Figure 1. Redshift versus distance. The thin line represents equation (25), the thick line the observed relationship.

These, results depend somewhat on our estimates of the density and radius of the universe, quantities that are not known with a high degree of accuracy. However, changes in the radius or density do not greatly alter the general nature of the predicted red shift curve. If the density were 10 times greater than estimated, this would increase the critical radius by a factor of 10, reducing the red shift in equation (25) by a corresponding factor of 10. Figure 1 indicates that this still results in much too high red shifts for most galaxies.

Could it be that the actual density is so high that the critical radius is R = 9S/8 and that the static model with pressure still applies? In that case, $R(t_2)/R(t_1) = 1$. For observer 2 at the earth, $r_2 = 0$, and equation (20) gives $g_{00}^{1/2}(r,) = 0$. Thus the light, as received at the earth, is shifted infinitely far to the blue (i.e., $\lambda_2 = 0$); significant time dilation in a static universe causes light from distant galaxies to be strongly blue shifted, which is not presently observed to be the case.

5. Conclusions

In summary, neither special nor general relativity appear to lend much support to the time dilation hypothesis. Although special relativity predicts time dilation due to motion, this is in the wrong direction. In the most natural general relativistic cosmological models (e.g., homogeneous or free-fall) gravitational time dilation does not apply and time dilation due to expansion is in the wrong direction.

Sufficiently large time dilation in the desired sense was found only in a static model with pressure. Unfortunately, this model has a number of serious problems that must still be overcome. The most important deficiency concerns the predicted red shifts, which differ drastically from the observed values. It is not clear how this can be resolved without the introduction of rather elaborate, artificial ad hoc modifications. Other difficulties include those of accounting for the pressure in the static phase and finding a physical cause for the brief burst of rapid expansion. There seems to be no obvious natural explanation as to why the universe should behave in such an eccentric manner.

Furthermore, it should be noted, that this model does not eliminate the need for "mature" creation of stars. Although, presumably, time dilation might allow distant stars sufficient time to develop via natural means, this is not the case for nearby stars. Certainly not for the Sun, where the cosmic gravitational potential - and hence the clock rate - is essentially the same as at the earth.

Of course, a cosmological model is not disproved by a mere inability to provide complete naturalistic explanations for all its details. Such shortcomings may merely reflect current human ignorance; further research might find viable remedies. On the other hand, it could be that naturalistic explanations fall short because of the existence of supernatural causes. In that case no scientific cosmological model will be adequate. Let us thus build our cosmological models with caution, testing them where possible with what God has revealed to us, and staying fully aware of their severe limitations.

Acknowledgements

The author gratefully expresses his thanks for helpful suggestions from the *CRSQ* editor and reviewers.

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LETTERS TO THE EDITOR

It's Just a Matter of Time

Before I get to the delightful chore of quibbling with John Byl over his article "On Time Dilation in Cosmology" (1997), let me mention several important points of agreement. First, we agree that young-earth creationism has not had, and needs, a good cosmology. Second, we agree that creationists can and should try to use general relativity to meet that need. If my book *Starlight and Time (1994)* is remembered for nothing else, it would please me greatly to see it remembered for breaking the ice in those two areas.

I also want to commend Dr. Byl for introducing and discussing some models of his own. I do not have space to discuss those models here, but I find them interesting. As I remarked in my book, if we have a *multiplicity* of young-earth cosmologies to choose from, we are much more likely to arrive at the truth.

Byl's Coordinates Conceal Time Dilation

Now, let's quibble! The essence of Byl's criticism of my model is in his section "Free-fall Models." After introducing the Robertson-Walker system of coordinates in his (metric) equation (3), he then asserts that "... there is no gravitational time dilation. All galactic clocks tick at the same rate."

Here Byl, perhaps unwittingly, has swept time dilation under the rug of a definition. The time coordinate he has chosen is *cosmic time* or "proper" time, which I explain on pages 89 and 92 of my book. I symbolize cosmic time by the Greek letter τ, but Byl symbolizes it by the Roman letter t (which will confuse readers wanting to compare the two papers). Cosmic time is the time registered by an ordinary clock *affected by gravity*.

Imagine a set of clocks which God synchronizes at the instant of creation, when everything is close together. Assign one clock to ride along with each newly-forming galaxy. As space and the galaxies expand outward away from each other, the clocks also move away from one another. Each one ticks at a rate determined by its position in the gravitational potential "well" Cosmic time defines two events in separate places as being "simultaneous" if the cosmic clocks in the two places have the same reading. By definition, *as measured by themselves*, "All galactic clocks tick at the same rate." The problem with this approach is that it defines time dilation right out of the picture.

A Parable Points Out the Problem with "Cosmic" Time

Let me illustrate the problem with an example borrowed wholesale from *Star Trek.* Imagine John Byl and myself standing on the bridge of the starship *Enterprise.* Both of us are wearing watches which have been synchronized with the ship's clocks. At the instant our watches are reading 5:00 p.m., a six-foot diameter "stasis bubble" sweeps onto the bridge and envelops John. The bubble (a science fiction concept) completely stops all physical processes within itself. It is a small but extreme form of time dilation. Five minutes later, as measured by the ship's clocks and my watch, the bubble disappears, leaving John apparently unharmed. His watch still reads 5:00 p.m.

I try to tell John what has happened to him. He denies that time had stopped for him, saying, "I did not feel anything, and my watch shows no sign of having stopped." I ask him about the fact that my watch and the ship's clocks are all reading 5:05 p.m. John says, "According to *my* definition of time, all clocks which agree with mine are in my present. Therefore, Russ, you and the whole ship must be five minutes into my future." When Mr. Spock attempts to reason with him, John insists quite loudly, "There is no such thing as time dilation!" Captain Kirk orders him to report to sick bay.

The point of my little parable is this: If time dilation actually occurs, John Byl's way of reckoning time prevents him from detecting it. His mistake shows up clearly when the time dilation region is small enough to allow clocks to be easily compared. Time dilation in a bounded cosmos would be spread over interstellar distances, so the inappropriateness of "cosmic" time would not be as obvious. Nevertheless, we must keep ourselves open to the possibility that time dilation may have actually occurred, not defining it away from our view. We need a different set of space and time coordinates, a set which will help us understand time dilation, not obscure it.

Schwarzschild Coordinates Help Clarify Things

The coordinates I favor are those used in the Klein metric, equations (16) through (18) on pages 116-117 of my book. The coordinate *t* in those equations is *Schwarzschild time,* which I went to great lengths to define and explain on page 102. Schwarzschild time is an idealized sort of time for conceptual purposes. It is the time which a stationary clock unaffected by gravity would register. I described several ways to try to make real clocks show Schwarzschild time. The result would be a system of clocks throughout the cosmos — all synchronized with, and at rest with respect to, clocks in empty space far beyond all matter.

With my equations, at any point in space we can compare these ideal, ethereal, totally unbiased Schwarzschild clocks with ordinary, mundane clocks reading cosmic time. I attribute any differences between the two sets to relativistic effects on the ordinary clocks. John Byl claims that (1) the only clocks that matter are the ordinary clocks, and (2) the Schwarzschild clocks can be used only *outside* the distribution of matter. His first claim is an unjustified opinion, and his second claim is not correct. I think that if Byl were pressed, he would admit that the Schwarzschild clocks and the Klein metric also give a perfectly correct physical description of things *inside* the matter distribution. What he is not saying, but should admit, is that he simply *prefers* the Robertson-Walker "cosmic time" metric for philosophical, non-objective reasons.

How Do We Measure a Clock's Rate?

Byl's assertion, "All galactic clocks tick at the same rate," contains the loose ends of its own unraveling. To specify the "rate" of one type of clock, we need to have another type of clock in the same location for comparison. If I tell you your watch is running slow, you have the right to ask what clock I am saying is correct. To what other type of clock is Byl comparing his cosmic clocks? He does not say. That renders his claim of "same rate" meaningless. Furthermore, according to Schwarzschild clocks, his statement is wrong; in a bounded universe, Byl's clocks tick at different rates (relative to my clocks) in different places.

Byl's clocks really should not be called "cosmic" at all. The name comes from applying his metric to an unbounded "Big Bang" cosmos, where a similar type of analysis would show that cosmic clocks and Schwarzschild clocks would indeed tick at the same rate everywhere. For the bounded, finite-mass, non-Big-Bang cosmos I propose, perhaps Byl's system should be called *local* clocks and *local* time.

First Witness: Stephen Hawking

Relativity experts all agree that the gravitational time dilation effects I speak of in my cosmology occur at the outer border of a black hole or white hole. They call this intangible spherical surface the *event horizon.* From the Robertson-Walker metric Byl cites in his equation (3), you would never suspect that the cosmos it describes has an event horizon. In fact Byl appears to imply that an event horizon cannot exist inside the collapsing ball of matter. Nevertheless it can! I call the well-known cosmologist Stephen Hawking as my first witness to that fact.

Figure 1 reproduces a figure from a book by Hawking and moderately-known relativist George Ellis, *The Large Scale Structure of Space-Time* (1973, p. 309). The figure shows a

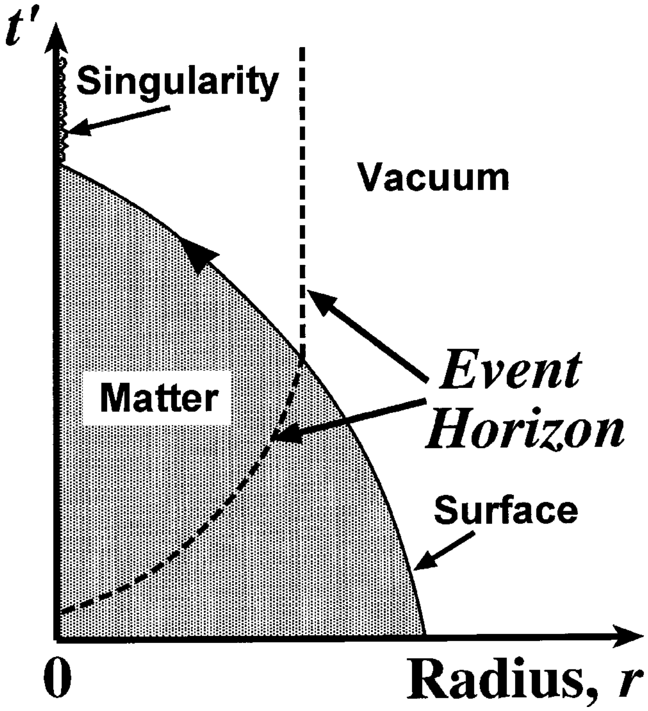

Figure 1. A collapsing ball of matter can contain an event horizon. Figure adapted from Figure 57 (i) of Hawking and Ellis (1973, p. 309). The horizontal axis is the Schwarzschild radial distance, *r*, from the center of the ball. The vertical axis is a time coordinate, *t*'. (Specifically, it is the Eddington-Finklestein time coordinate, the sum of the Schwarzschild time *t* plus a function of *r*.) The shaded part of the figure represents the interior of the ball. The dotted line shows the event horizon, where time dilation occurs.

radius-versus-time plot of the collapse of a ball of matter, such as a spherical cluster of galaxies. Turning the figure upside down would illustrate the cosmology I propose, the expansion of galaxies out of a white hole.

The shaded part of the figure represents the interior of the ball of matter; the white part is the vacuum outside the ball. The shaded part is exactly what Byl's equation (3), the Robertson-Walker metric, is supposed to represent. The dotted line is what Hawking and Ellis label as the event horizon. Notice that part of the event horizon is in the shaded part, i.e., *inside* the ball. As matter collapses, the event horizon moves outward until all the matter is within it, after which it stops moving and stays at a constant radius. At that point, the event horizon marks the outer border of a classical black hole.

My point is that Byl's metric, equation (3), cannot show us the location of the dotted line when it is inside the ball of matter. His choice of "cosmic" time renders the event horizon (and the time dilation at that location) invisible. On the other hand, we can use my equations, the Klein metric and Schwarzschild time, to explicitly trace out the location of the event horizon inside the ball of matter. Byl's choice of coordinates conceals important and very real physical effects, including time dilation. The coordinates I use make the time dilation evident.

World-Class Relativists Disagree with Byl

If the testimony of Hawking and Ellis is not enough, I can call other famous cosmologists as witnesses. As just one example, a well-known graduate textbook, *The Classical Theory of Fields* (1975, p. 320), by the Russian physicists Lev Landau and Evgeny Lifshitz, shows a figure similar to mine which describes the same physical situation. Their figure, while using less intuitive coordinates, has the benefit of showing an expansion (a white hole) before the contraction (a black hole). Their figure shows the event horizon expanding outward from radius zero (and therefore from within the ball of matter) during the contraction, just as does the figure in Hawking and Ellis. I could cite other examples from other well-known authors.

All these authors speak of a real time dilation at the event horizon. Hawking gives a vivid popular account of some of the time-distorting effects in his best-selling book, *A Brief History of Time* (1988, p. 87). It does not matter whether the event horizon is inside or outside all of the collapsing material — the time distortions still exist at the horizon. In denying the reality of time dilation in this situation, John Byl is in effect denying the recent decades of hard work on black holes by world-class general relativists. It is not a good position to be in, and I do not think he intended to put himself into it. If Byl is wrong on this one point, then his principal criticism of my cosmological model evaporates.

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"Triassic" of Colorado National Monument Possibly of Equivalent Age to "Middle Cambrian" of Grand Canyon

Information in David V. Harris and Eugene P. Kiver (1985, pp. 247-250) can be used to challenge evolutionary geologic time. They deal with the geologic strata within the Colorado National Monument. Figure 11-15, on page 249 is *a columnar section of formations in Colorado National*

Monument, where U-I is described as a *major unconformity* with what they call “Older Precambrian” below and the “Triassic” Chinle Formation above. U-II and U-III are *disconformities* separating the Kayenta from the Entrada Formations and the Burro Canyon from the Dakota Sandstone Formations, respectively. The section of formations is adopted from Lohman, 1965.

It is my belief that the major unconformity shown in their Figure 11-15 can be utilized to criticize evolutionary geology by comparing it with another major unconformity that is in the columnar section of formations for the Grand Canyon of the Colorado. In the Grand Canyon, an evolution-aged, *Middle Cambrian,* Tapeats Sandstone lies unconformably on *Pre-Cambrian* rocks. The Tapeats is about 550 million years old; so say the evolutionists.

Within the Colorado National Monument, in contrast, it is an evolution-aged, *Triassic* formation (the Chinle) that lies unconformably on *Pre-Cambrian rocks.* The Chinle Formation is about 225 million years old, making the formation about 225 million years younger than the Grand Canyon’s Tapeats Sandstone.

One evolutionary conclusion for Pre-Cambrian rocks under Colorado National Monument is that the rocks had been eroded continuously for more than 225 million years prior to deposition of the Triassic Chinle Formation, resulting in what Harris and Kiver claim is a “Great Unconformity.” As a consequence of continuous erosion, Cambrian strata and strata from the Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian and Permian Periods are missing. In simple terms, the entire Paleozoic Era is missing!

A second evolutionary conclusion could be that some Paleozoic strata may have been deposited but then eroded, prior to Chinle times. This would mean that in the vicinity, there would be products of Paleozoic erosions as limestone cobbles and boulders with Paleozoic fossils in them deposited in Chinle Formation beds: Are there such beds?

A creationist conclusion could be that the term, Paleozoic Era, is a figment of 19th century imagination. Because the Triassic Chinle Formation within the Colorado National Monument and the Middle Cambrian, Tapeats Sandstone of the Grand Canyon each lie directly on Pre-Cambrian rocks, it can be argued-based on the principle’ of Multiple Working Hypotheses-that *the Chinle and the Tapeats are of equivalent age.* Both rest directly on, for lack of a currently better description, the Pre-Cambrian rocks. Both the Chinle and the Tapeats could have been deposited at the same time, but in different environments.

Evidence for age-equivalence, a creation working hypothesis is that the Chinle Formation has not been found lying above the Tapeats Sandstone in any surficially viewed, columnar section of formations in areas lying between the Grand Canyon and Colorado National Monument. Other evidence is that there are no regional data indicating a withdrawal of seas for millions of years followed by their return; resulting in minor disconformities found in the Colorado National Monument and in the Grand Canyon. It may be that the minor disconformities of both areas are “correlatable.” Correlation of disconformities could also be evidence of age-equivalence.

Good science practice demands that geologists go back to using Multiple Working Hypotheses when attempting to explain the unexplainable. In my opinion, when they do return to good practice, the majority will realize that evolution is figmental.

A thorough study of the Colorado National Monument and vicinity and its structural-stratigraphic relationship with Grand Canyon is recommended.

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PANORAMA NOTES

Xenoliths in Stone Mountain Granite: Evidence for Rapid Emplacement and Cooling of the Granitic Magma

Introduction

Young-earth geoscientists suggest a catastrophic interpretation for much of the stratigraphic record. We use the same physical evidence as our uniformitarian counterparts in developing theories which work within our model requirements. However, we seek to challenge many of the assumptions of the uniformitarian model. Sometimes in our evaluation of the existing theories we discover discrepancies between the physical evidence and the current uniformitarian theory. Such is the case for this paper. Igneous intrusive rock, specifically granite, is commonly interpreted by uniformitarian geologists as being emplaced within the earth by rising magma plumes generated as a result of collision between continental landmasses. Additionally, it is suggested that millions of years were required to form, emplace, cool, solidify, and in some cases unroof the granitic masses. Stone Mountain, Georgia is one such granitic pluton which is believed to have formed in this manner. However, a young-earth theory for Stone Mountain's formation and eventual exposure has previously been proposed (Froede, 1995). Any theory used to explain the formation of the Stone Mountain Granite should be supported by the physical evidence(s) found at the pluton. Xenoliths provide us with one such test of the uniformitarian theory. The author suggests that xenoliths found in the Stone Mountain Granite fail to support the uniformitarian theory involving millions of years of cooling whether one invokes shallow or deep emplacement of the magma mass. This short note will attempt to show that the xenoliths found within the Stone Mountain Granite present an enigma within the current uniformitarian interpretation. Rather, their occurrence suggests that the granite was rapidly emplaced, cooled, and solidified.

Xenoliths

Allaby and Allaby (1990, p. 406) defined a xenolith as:

> An inclusion or enclave of a pre-existing rock in an igneous rock. Xenoliths are often derived from country rocks that have been invaded by the igneous mass, and they frequently show some evidence of reaction, e.g., rounding of their edges and metamorphism.

Xenoliths are found in many different types of igneous rocks (e.g., basalts, carbonatite, granites, peridotites, and in rhyolitic volcanic rocks) which are today exposed at the Earth's surface (Hyndman, 1972). The xenoliths of interest for this paper are found in the granitic rock at Stone Mountain, Georgia (Figures 1 and 2).

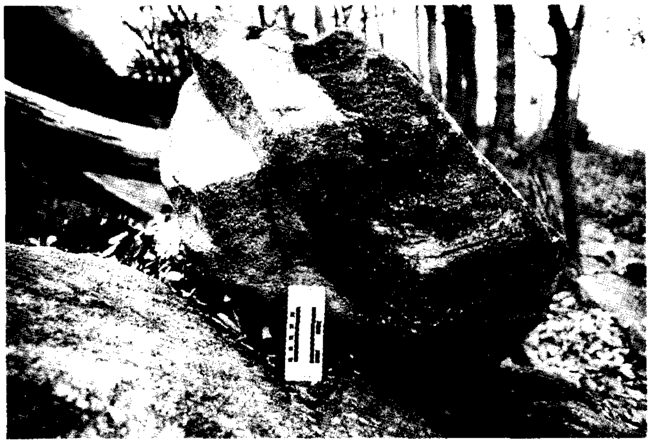

Figure 1. A biotite gneiss xenolith is exposed in this exfoliated granite boulder found along the base of Stone Mountain. Scale in inches and centimeters.

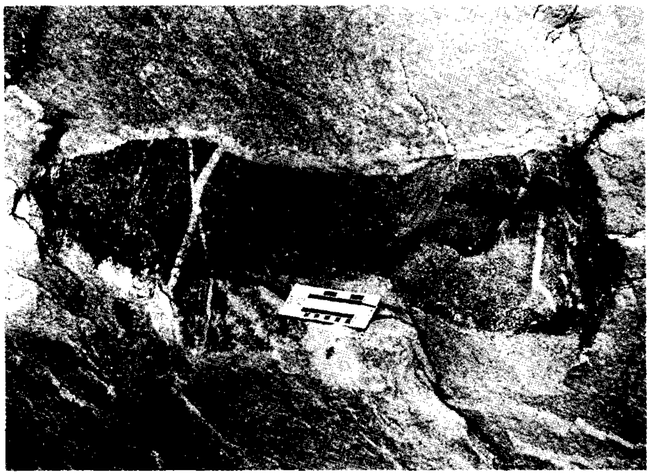

Figure 2. Xenolith exposed in the former granite quarry located on the east end of the Stone Mountain pluton. This area has undergone extensive granite removal and it can be estimated that several feet of overlying granite have been removed to expose this biotite gneiss xenolith. Note the somewhat rounded contact surface with the surrounding Stone Mountain Granite. Scale in inches and centimeters.

Hermann (1954, p. 57) described the xenoliths found in the Stone Mountain Granite as biotite-rich gneiss. These xenoliths are suggested as having mineral compositions and textures similar to those in the adjacent country rock. Lithologic variations include biotite, muscovite-biotite, and garnet-mica schists, and less commonly, biotite-plagioclase gneiss and granite gneiss (Grant, Size, and O'Conner, 1980, p. 47).

Xenolith Formation

Tectonic forces are suggested as both generating and driving granitic magma upward into and through the overlying rocks. Blocks of the surrounding and overlying rock (identified as "country rock" by geologists) break and form the xenoliths found within the magma. With ample heat the xenoliths melt and mix with the magma. This mixing of melted country rock with the magma has been recognized in various granitic rocks (Hyndman, 1972, p. 85; Barker, 1983, p. 136). However, if the heat were insufficient to immediately melt the xenoliths, they would float in the granitic magma and undergo various stages of assimilation with the surrounding magma, even to the point of total disintegration. If the granite mass had cooled below the assimilation point of the xenolith, then it would remain unchanged throughout the granite's crystallization history.

The uniformitarian model suggests that most if not all xenoliths existed for thousands, if not millions, of years in the magma while it slowly cooled in the subsurface forming granite. This model requires the loss of driving energy (i.e., tectonism) to allow for large-scale cooling to occur. If xenoliths are present then they would reflect the movement of the granitic magma, specifically the movement of the magmatic mass into the overlying and surrounding rock. This would be true whether one invokes plastic or brittle fracturing of the surrounding country rock by the rising granitic mass.

This then raises serious questions regarding the occurrence of xenoliths within granitic magma. If xenoliths are viewed as late emplacement features then their existence would suggest that some sort of additional force was necessary to result in their generation (i.e., brittle-rock faulting of the surrounding and overlying country rock), without the generation of additional heat. However, if they formed early in the emplacement process, they would have been exposed to much more heat for longer periods of time.

Evidences of Rapid Cooling at Stone Mountain

The fact that xenoliths exist not only along the outer surface of granitic magma but also within it presents interesting issues regarding granitic magma emplacement and cooling rate. Xenolith preservation within the magma along with its physical condition can lead us to formulate various theories within a catastrophic framework.

First, if the xenoliths existed for thousands to millions of years in the granitic magma *BEFORE* it cooled and solidified, then it should be reflected by a smooth (i.e., rounded) outer surface (Figures 2 and 3). Many xenoliths occur in granites which have this characteristic. Additionally, the outer boundary of the xenolith should show a gradational effect (i.e., assimilation) due to the partial melting of the xenolith into the granitic magma. However, if the xenolith was rapidly plucked from the surrounding rock and subsequently embedded in the granitic magma which was undergoing rapid cooling then the surface would be more sharp than smooth and there would be little to no gradational transition between the xenolith and the granitic magma (Figure 3).

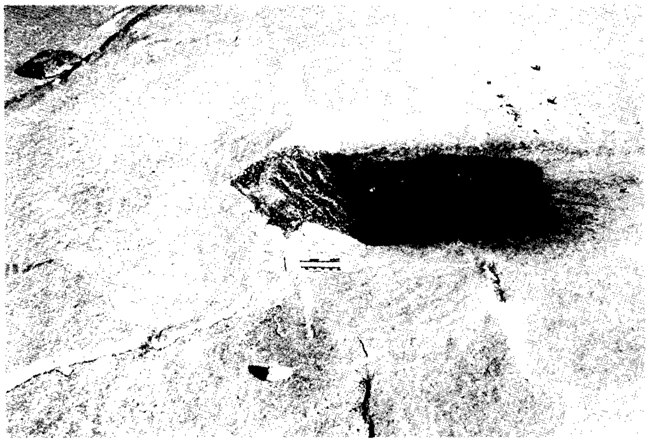

Figure 3. Another xenolith exposed in the former quarry in Stone Mountain Granite. Note the somewhat sharper shape of the xenolith. Scale in inches and centimeters.

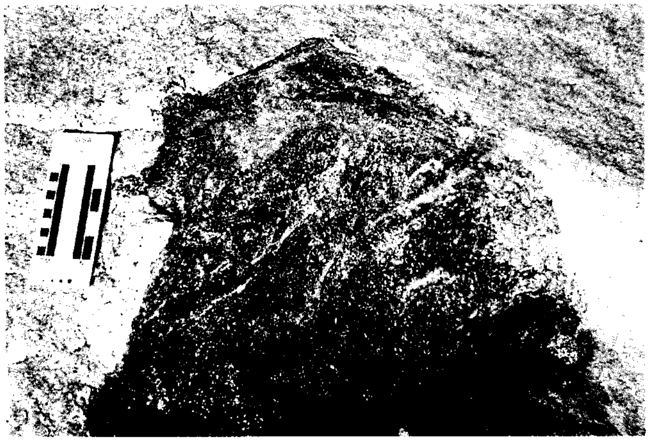

Figure 4. Close-up showing the lack of a gradational effect caused by the purported millions of years of cooling which the granite underwent as it cooled deep in the subsurface. This contact would be described as having chilled margins due to incomplete mixing or gradual assimilation. Scale in inches and centimeters.

Second, if the xenolith were "floating" in the granitic magma for thousands to millions of years, it should have been subject to plastic deformation due to the heat and pressure associated with the granitic magma and its upward movement. This should hold true whether the granitic magma was emplaced either shallow or at depth. Xenoliths examined in the Stone Mountain Granite show no evidences of any plastic deformation (Figure 4). If they were incorporated within a rapidly cooling granitic magma, no plastic deformation would be expected.

Conclusions

The condition of the xenoliths found at Stone Mountain are suggested as reflecting the temperature and pressure to which they were exposed as they became part of the granitic magma. That they do not share a gradational contact reflects the rapid decrease in heat content of the magma (Figure 5).

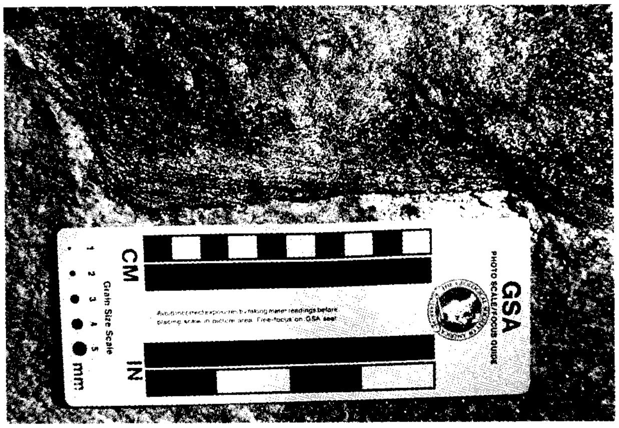

Figure 5. Extreme close-up of xenolith/granite contact from Figure 4. If this block were exposed to millions of years of both heat and pressure it should be reflected by a gradational outer surface and possibly even plastic deformation. These characteristics were not observed in any of the xenoliths observed.

The lack of plastic deformation reveals the brittle nature of the original country rock. Its retention of that property reflects the lack of sufficient magmatic heat and pressure to change it into a plastic state. That it is a separate and distinct piece of rock with little to no gradational zone within the granite pluton can only result from its late capture and the granitic magma's rapid cooling. Hence, it would appear that the xenoliths exposed in the Stone Mountain Granite support a more catastrophic interpretation for their occurrence and subsequent exposure than is currently suggested by the uniformitarian theory.

Acknowledgements

The author thanks J. C. Meredith and Dr. J. K. Reed, along with other individuals who have reviewed and edited this article. Thanks also to my wife Susan who continues to support me in my research and writing efforts. Glory to God in the highest (Pr 3:5-6).

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Cloudland Canyon State Park, Georgia: 300 Million Years of Erosion?

Introduction

Many of Earth's surface features are suggested by uniformitarian geology as forming over the course of millions of years. The Young-Earth Flood Model requires our interpretation of these same geomorphic features as forming within much shorter time frames. We observe the same physical features as our uniformitarian counterparts, but we interpret these features within the framework of our own model. One locale which appears to better support the Young-Earth Flood Model time frame for development is found in Cloudland Canyon State Park located in Northwest Georgia. A glossary is provided to aid the reader in understanding some of the terminology.

Site Location

Cloudland Canyon State Park is found in Dade County, Northwest Georgia (Figure 1). The Park is located adjacent to the Cumberland Plateau in the northwestern corner of the state (Griffin and Atkins, 1983, p. 1). According to Cook, Brown, and Oliver (1990, p. 146), this area lies within the Valley and Ridge Province. This province is summarized (Fairbridge, 1968, pp. 946) as :

> ...(a) a province of uniform structural origin; (b) developed in sedimentary rocks; (c) monotonously folded into parallel, symmetric (sometimes isoclinal) anticlines and synclines; (d) peneplained to give a general summit accordance; (e) subject to subsequent discontinuous upwarping resulting in multiple secondary erosion surfaces; (f) differential erosion that has picked out distinctive lithologies - ridge formers and valley formers - to provide series of parallel mountains and valleys, marked by distinctive trellis drainage pattern.

Because of its beauty and potential for enjoyment, the State of Georgia made this area into Cloudland Canyon State Park. Within the boundaries of this park, two unnamed canyons (herein referred to as Daniel Creek Canyon and Bear Creek Canyon) combine to form Sitton Gulch. Only Daniel Creek Canyon has been developed to allow the individual to travel to its base (using stairs) and to view the sheer canyon sidewalls and two waterfalls. Sitton Gulch, Daniel, and Bear Creek canyons are all suggested to have formed due to overland flow of water draining toward the western side of the Lookout Mountain Ridge.

Tectonic Site History

The Lookout Mountain Ridge formed as part of the Southern, Appalachian Mountain orogeny (i.e., mountain building event). Present uniformitarian interpretation sug-

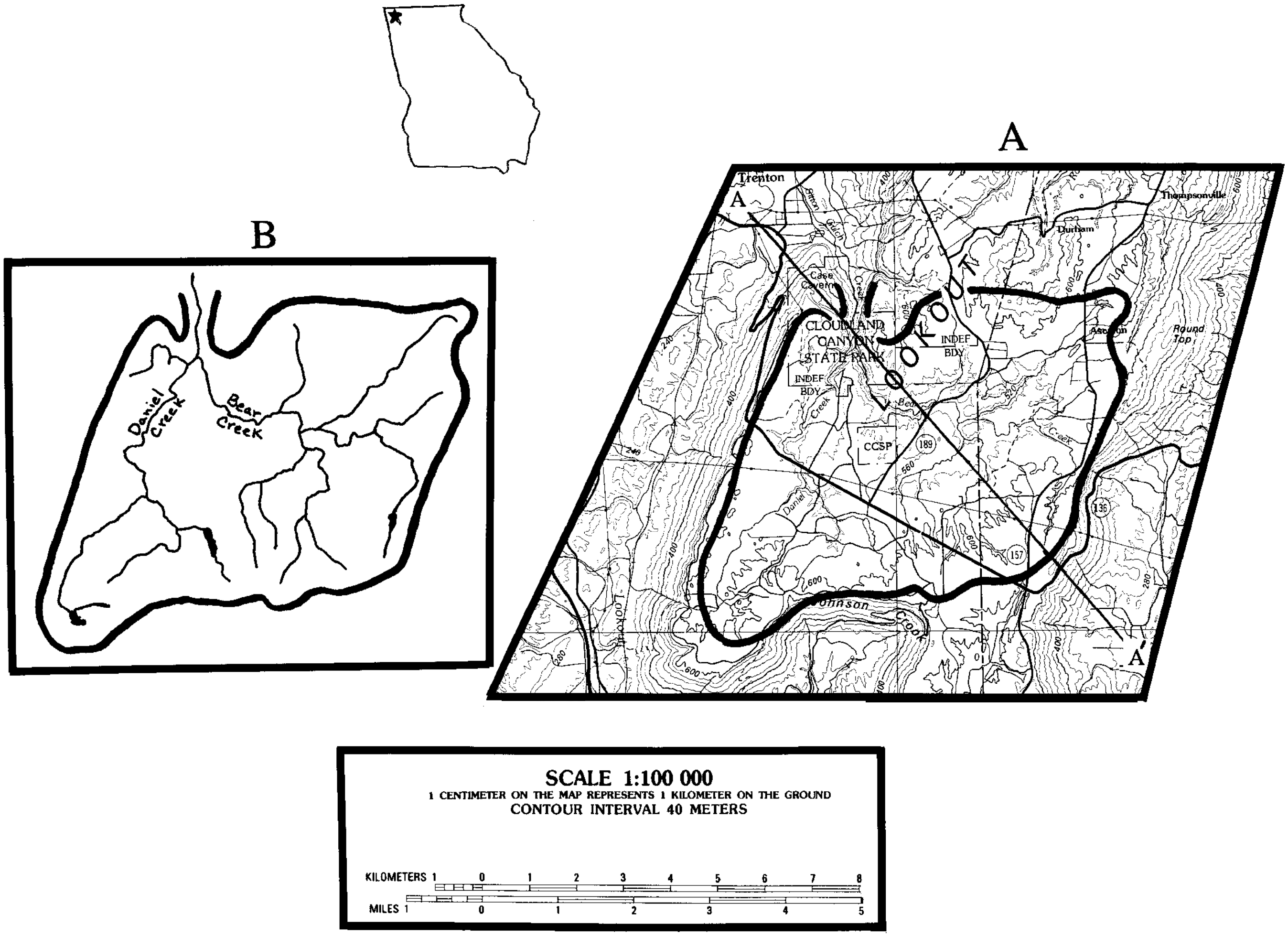
A
B
Trenton
Thompsonville
Durham
Case Cavern
CLOUDLAND CANYON STATE PARK
INDEF BDY
INDEF BDY
CCSP
Daniel Creek
Bear Creek
Round Top
Johnson Creek
A
A'
SCALE 1:100 000
1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 40 METERS
KILOMETERS 1 0 1 2 3 4 5 6 7 8
MILES 1 0 1 2 3 4 5

Figure 1. a) U.S. Geological Survey map showing the general, area surrounding Cloudland Canyon State Park. Generalized cross-section is represented in diagonal line (see Figure 5). Note sizes of the canyons which are said to represent 300 million years of erosion. b) A watershed map at the same scale as the topographic map. This map shows the areas drained by both Daniel Creek and Bear Creek. The amount of time of erosion postulated for this site (i.e., 300 million years) should result in a larger watershed than is found. Additionally, canyon development should be much more extensive. The millions of years of "ice age" precipitation (uniformitarian estimate) alone should have resulted in greater canyon development than what is found at present. Note the size of the areas drained.

gests the ridge formed in the post-early Pennsylvanian (Thomas and Neathery, 1980, p. 484). According to Windley (1995, p. 212) this tectonic time frame involved west-directed thrust sheets and folding. By uniformitarian dating methods, Lookout Mountain Ridge formed approximately 320-300 million years ago (Gordon and Mamet, 1978, p. 327). Since that time the mountain ridge has been undergoing erosion which has served to peneplain (i.e., evenly erode downward) the original top of the mountain ridge, carrying the sediments from the top to the adjacent valley floor. Sullivan (1942, p. 5) has characterized the trellis drainage pattern on the top of Lookout Mountain as submature (i.e., still, in an active phase of erosion).

Formation of the Canyons

Both Daniel and Bear creeks serve to drain water from the top of Lookout Mountain Ridge and, are suggested as having formed their respective canyons as a result of downcutting through rocks broken by fractures (Griffin and Atkins, 1983, p. 19-21). However, what is interesting about these two creeks is that they are extremely small (i.e., underfit) when compared to what would be expected based on the size of the canyons found (Figures, 2, 3 and 4). Additionally, the drainage basin (i.e., water shed) of these creeks is also relatively small (Figure lb). A simple cross-section across Lookout Mountain reveals the slope of the top surface of the mountain as being toward the west-northwest, and it is this slope which directs overland flow of the surface water toward Bear and Daniel creeks (Figure 5 and Figure la).

The strata which are exposed along the sidewalls of Daniel and Bear Creek canyons (moving from bottom to top - Pennington Formation (Mississippian), Raccoon Mountain Member, Warren Point Member, and the Sewanee Member, all of the Gizzard Formation (Pennsylvanian) are

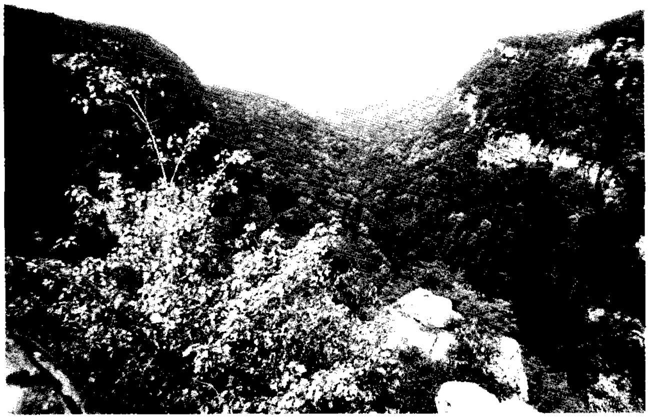

Figure 2. Photograph facing toward the northwest showing Sitton Gulch. Note sandstone sidewalls form the vertical cliffs, while the softer shales form slopes.

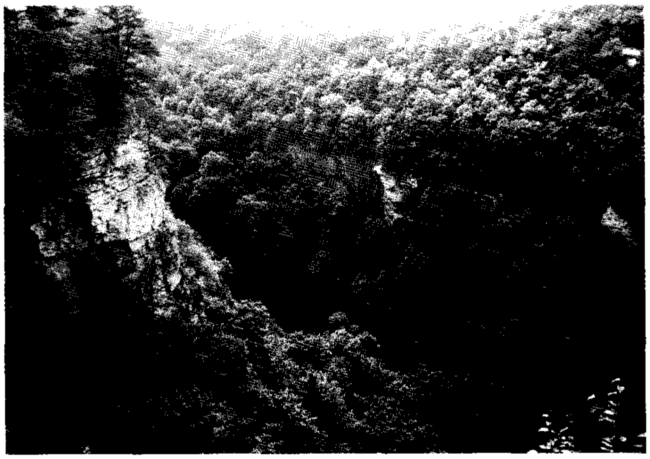

Figure 3. Daniel Creek Canyon. Note the sheer cliff face formed by jointing which occurs in the sandstones. Also note the width of the canyon.

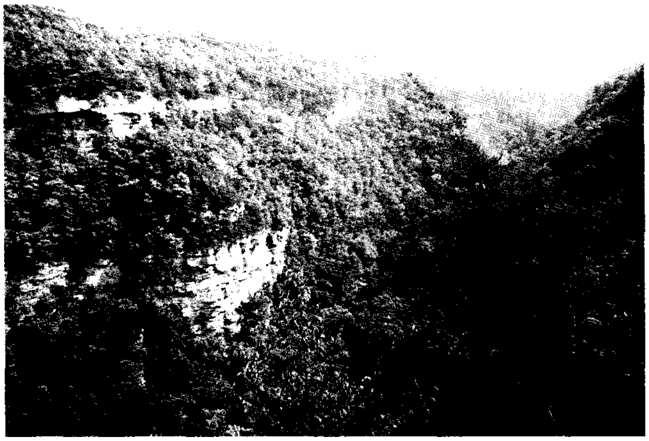

Figure 4. Bear Creek Canyon. This canyon drains a larger section of the Lookout Mountain Ridge and has resulted in the formation of a canyon which is larger than that of Daniel Creek Canyon. However, 300 million years of erosion should have resulted in a deeper and wider canyon than is exhibited in this photograph.

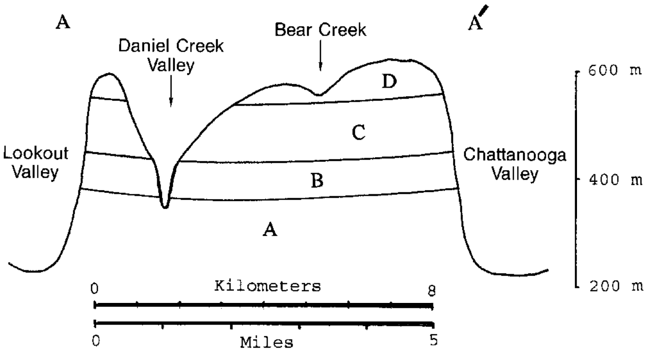

Figure 5. Northwest (A) to southeast (A') generalized cross-section across the Lookout Mountain Ridge. The line of section is shown in Figure la. The slight upward curve of the strata reflect the synclinal shape of the ridge. Note that the scale is exaggerated. The vertical scale is based on relative sea-level. The top surface of the Lookout Mountain Ridge dips toward the northwest and serves to direct the overland flow of water towards Lookout Valley. This overland flow from Lookout Mountain Ridge has resulted in the formation of Daniel and Bear creeks and their respective canyons. Generalized stratigraphic section is presented as: A) Pennington Formation (Mississippian), B) Raccoon Mountain Member, C) Warren Point Member, and D) Sewanee Member-all part of the Gizzard Formation (Pennsylvanian).

all nearly horizontal layers of sandstone, siltstone, quartz-pebble conglomerate, and shale (Figure 5). These clastic strata easily compare to clastic layers found exposed in the sidewalls of the Grand Canyon (see Breed, Stefanic, and Billingsley, 1986). This similarity is mentioned to help the reader realize that there is no difference in the hardness between clastic rock strata found in either Cloudland or the Grand Canyon - they are both the same types of clastic materials with similar hardness and resistance to erosion.

The cross-section of the Lookout Mountain Ridge reveals the synclinal nature of the strata (Figure 5 and Figure la). The slightly upward concavity of the strata reflects the tectonic forces which served to fold the originally horizontal sediments into the Valley and Ridge Province observed today. Note that these layers are also exposed along opposing sides of the Lookout Mountain Ridge in the Lookout and Chattanooga valleys. This suggests that tremendous amounts of erosion must have occurred to remove the two originally adjacent anticlines (on either side of the Lookout Mountain Ridge) and leave all but this synclinal ridge of rock (Figure 5).

Some would suggest that the Lookout Valley (located to the west of the Lookout Mountain Ridge) is actually the main canyon and that Daniel and Bear Creek canyons should only be considered as side canyons (see Figure 1). However, a closer examination reveals that Lookout Valley is actually an eroded anticline. As the original anticline eroded downward it would have reached a point where the top of the anticline was at the same elevation as the top of the syncline. As the anticline eroded further downward the top of the syncline would have drained water across its upper surface into the anticlinal valley. With the millions of years suggested by uniformitarians to accomplish the erosion of the anticlinal valley one would expect the synclinal upper surface to develop well incised creeks and streams across its surface. Rather, what we find is a steep sided synclinal ridge (Lookout Mountain Ridge), with surface water discharge occurring as waterfalls into small canyons which eventually open to Lookout Valley. It would appear that Lookout Valley was catastrophically formed with the adjacent Lookout Mountain synclinal ridge remaining as an elevated surface. Otherwise how could the cliff sidewalls of the Lookout Mountain Ridge syncline be explained. It would be more reasonable to expect no sheer sidewalls of the Lookout Mountain Ridge due to long term erosion and its lateral integration with the adjoining anticlinal valleys.

The author finds the minimal sizes of the Daniel Creek and Bear Creek canyons very strange if they have been draining surface water into Lookout Valley for approximately 300 million years. Sullivan (1942, p. 7) interprets these two canyons as yet incomplete in headward erosion (still youthful), leaving the top through an inconspicuous gap (i.e., Sitton Gulch). Comparing the canyons at Cloudland Canyon State Park to the Grand Canyon raises even more questions.

Grand Canyon Analogy

According to modern uniformitarian estimates, the Grand Canyon could have formed within a short timespan (Figure 6). Lucchitta (1990, p. 332) states:

> A striking conclusion that emerges from the study of the Colorado River is that even a canyon as intricate and immense as the Grand can be carved in a surprisingly short time -*five million years,* probably substantially less, in spite of the tough and remarkably undeformed rocks that make up its walls. (emphasis mine)

However, work performed by Austin (1994, pp. 92-107) suggests that the Grand Canyon could have formed within much less time, thus satisfying the Young-Earth Flood Model time frame requirements.

The two canyons located within Cloudland Canyon State Park are both approximately 800 feet deep (Griffin and Atkins, 1983, p. 1). They extend, from Sitton Gulch into the Lookout Mountain Ridge approximately 3500 feet (Daniel Creek Canyon) and 8500 feet (Bear Creek Canyon). These canyons are suggested as having drained water from the top of Lookout Mountain for possibly 300 million years. Both formed due to precipitation and overland flow, in an area which has always had higher precipitation rates than the Grand Canyon region. Yet we see that while they are not exactly small canyons, they appear to have “weathered” at lesser rates when compared to the Grand Canyon. Since both areas (i.e., Daniel and Bear Creek canyons along with the Grand Canyon) contain similar clastic rock types (and comparable rock hardness), this author finds it most strange that there exists a vast difference in the canyon sizes, specifically the short lengths and depths of the canyons. According to uniformitarian theory, both Daniel and Bear creeks within Cloudland Canyon State Park have had **60 times** the length of time to incise themselves as has the Colorado River in the Grand Canyon. In 300 million years of erosion neither Daniel nor Bear Creek canyons have succeeded in eroding their way across the width of Lookout Mountain Ridge (approximately 3.5 to 4 miles in width). Weathering rates (i.e., overland flow, freeze and thaw, etc.), suggested for the Cloudland Canyon site (for 300 million years) should have resulted in a more extensive canyon system than is presently observed. The current uniformitarian theory fails to support what would be expected for the canyons based on their suggested erosional cycles and time frames.

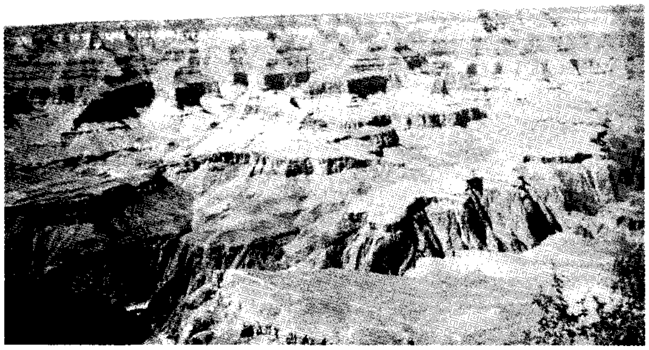

Figure 6. The Grand Canyon. Taken from the south rim looking toward the north. Uniformitarians now suggest that this canyon could have formed in as little as five million years (Lucchitta, 1990). However, Young-Earth creationists suggest only hundreds of years are required (see text for further explanation). The Daniel Creek and Bear Creek canyons have had supposedly 300 million years to form by the same physical processes that formed the Grand Canyon. Compare this photograph to Figures 2, 3, and 4.

Young-Earth Flood Model

The Lookout Mountain ridge formed as part of the southern Appalachian Mountain orogeny during the Flood Event Timeframe (see Froede, 1995a; 1995b).

The flat-lying strata were compressed due to tectonic forces in effect during the Flood. These forces resulted in the formation of anticlines and synclines. These semi-lithified sediments were then aggressively eroded away starting with the uppermost exposed surface (i.e., the tops of the anticline's). This erosion resulted in the eventual formation of

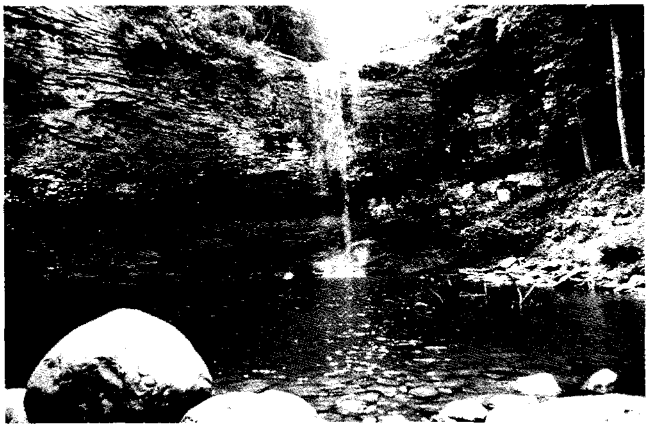

Figure 7. The upper falls of Daniel Creek Large cirque-shaped basin reflects "wet" weather in earth's past. The waterfall is approximately 50 feet in height and is believed to have carved this upper falls basin through increased water flow levels by abrasive erosion (Griffin and Atkins, 1983, p. 9). The combination of higher water flows, semi-lithified nature of the sediments, and an increase in the sediment carrying capacity (for abrasive; erosion) is predicted during the Upper Flood Event/Lower Ice Age Timeframes. Today, this creek only approaches past precipitation levels during intense storm events. However, the amounts of sediments eroded today do not occur at the same levels as has occurred in Earth's past. Today we see underfit creeks carrying little to no sedimentary materials, flowing through both canyons.

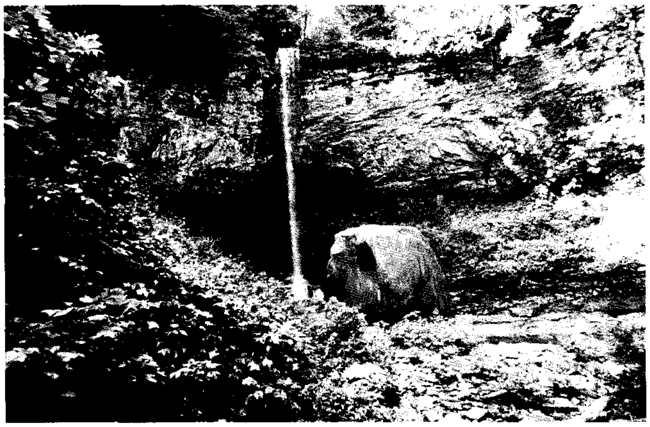

Figure 8. The lower falls of Daniel Creek. Again note the "underfit" size of the waterfall in relationship to the water which pours over it and its cirque (or bowl) shape. This waterfall is approximately 90 feet from the top to its base (Griffin and Atkins, 1983, p. 22). The boulder in the foreground is a jointed block of Warren Point Sandstone. Block is approximately 18 square feet. Again note the size of the basin in relationship to the waterfall.

synclinal ridges (like Lookout Mountain) as elevated features with the adjacent anticlines forming eroded canyons. This is opposite to what would, be expected in the formation of canyons using no catastrophic processes. However, this is the way the Valley and Ridge occurs at Lookout Mountain.

Both Daniel Creek Canyon and Bear Creek Canyon were initiated on the top of Lookout Mountain Ridge following the draining of the Flood waters. Starting at Sitton Gulch, both creeks made headward erosion into the Lookout Mountain Ridge probably rapidly at first due to the semi-lithified nature of the strata. Also precipitation was probably higher than present due to the climatic instability associated with the end of the Flood and onset of the Ice Age Timeframe (Oard, 1990, pp. 33-65; Vardiman, 1993; 1994). These higher-than-present precipitation rates served to create many bowl-shaped depressions which are recognized as wet-weather waterfalls (Figures 7 and 8). According to Griffin and Atkins (1983, p. 14):

> Wet weather waterfalls have carved these concave depressions through the cutting action of turbulent, sediment laden water.

Nott and Price (1994) have suggested a means of evaluating paleo-precipitation through the investigation of plunge pool deposits found in association with waterfalls. However, this author does not see applicability of this methodology for the two waterfalls found at Cloudland Canyon State Park. Hence, at this time there is no means of determining the rate in which paleo-precipitation formed these wet weather waterfalls.

With the final lithification of the sediments, probably during the Lower Ice Age Timeframe, the erosion of the canyons slowed resulting in the formation of the large cirque-like waterfalls. Using the young-earth Flood model, the Daniel and Bear Creek canyons would then be no older than 3,000 to 4,000 years.

Conclusions

The short time frames required by the Young-Earth Flood Model suggest the formation of the two canyons found in Cloudland Canyon State Park, within several thousand years vs. the uniformitarian estimate of up to 300 million years.

Using uniformitarian time frames, when compared to the formation of the Grand Canyon in as little as five million years, Bear and Daniel Creek canyons fail to justify their small sizes, especially if 300 million years elapsed to erode the top of the Lookout Mountain syncline. Additionally, the lack of incised creek valleys extending across the Lookout Mountain Ridge fails to support the possibility that this upper surface has been eroded by Daniel or Bear creeks over the course of millions of years.

The sheer sidewalls of Lookout Mountain Ridge suggest that the overland flow of water has not contributed greatly to the erosion of this synclinal ridge. The physical evidences fail to support a 300 million year erosion period. Rather, it would appear that the creeks are new to the scene and have only been eroding the top of Lookout Mountain ridge for thousands of years. Their respective canyons further suggest that precipitation rates were higher in the past than they are presently. The shapes of the plunge pools suggest that the creeks have reached an end to their major erosional energy. which is probably tied to both the loss of more abundant precipitation conditions in Earth's past, and the eventual full lithification of the sediments composing the ridge. Hence, the evidence appears to support the development of Daniel and Bear creeks and their respective canyons recently.

Glossary

Anticline -A fold, generally convex upward, whose core contains the stratigraphically older rocks (Bates and Jackson, 1987, p. 29).

Cirque - A term sometimes used for a semicircular, amphitheater-like, or armchair-shaped hollow of nonglacial origin but resembling a glacial cirque (Bates and Jackson, 1987, p. 120).

Orogeny - The process by which structures within foldbelt mountainous areas were formed, including thrusting, folding, and faulting in the outer and higher layers, and plastic folding, metamorphism, and plutonism in the inner and deeper layers (Bates and Jackson, 1987, p. 467).

Peneplain - A low, nearly featureless, gently undulating land surface of considerable area, which presumably has been produced by the process of long-continued subaerial erosion (primarily mass-wasting of and sheetwash on interstream areas of a mature landscape, assisted by stream erosion) almost to base level in the penultimate stage of a humid, fluvial geomorphic cycle (Bates and Jackson, 1987, p. 490).

Syncline - A fold of which the core contains the stratigraphically younger rocks; it is generally concave upward (Bates and Jackson, 1987, p. 667).

Acknowledgements

The author thanks J. C. Meredith and Dr. E. L. Williams along with other reviewers for their helpful comments. Additionally, I express my gratitude to my wife Susan for giving me the time to study and write this article. Glory to God in the highest (Pr 3:5-6).

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Carl R. Froede, Jr.*

BOOK REVIEWS

A Christian Perspective on Creation vs. Evolution by Michael L. Mccoy. 1996. Concordia publishing House. St. Louis. 76 pages. $5.00.

Reviewed by Don B. DeYoung**

This is the book that some have been waiting for, a clear study guide on creation-evolution. The author presents four lessons along with followup questions for discussion. Detailed origin evidences and dating methods are not covered. Instead the book probes secular and Christian worldviews, and also the scientific method. Many thoughtful statements are included: Science itself is not the enemy of creation (p. 21). Atheists are made, not born (p. 29).

The author shows how to graciously present the gospel to skeptics. Writers quoted include Camus, Dostoevski and C. S. Lewis. The book is permeated with evangelism in a positive, nonconfrontational style. This short book has a beautiful cover and references for further study. Well done!

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Alternative Science; Challenging the Myths of the Scientific Establishment by Richard Milton. Park Street Press. Rochester, VT. 1996. 264 pp. $14.95.

Reviewed by Jerry Bergman*

This enjoyable, lively book vividly documents that scientists often manifest a level of intolerance commonly associated with religious fanatics or the irrational governments of Hitler or Stalin. Milton begins with the history of the existence of meteorites, noting it was at one time widely believed that stones do fall from the sky-and then the advancement of science concluded that such could not occur. Consequently "museums all over Europe had thrown out their cherished meteorite specimens with the rubbish as humiliating reminders of a superstitious past" (p. 3). As a result, hardly a single specimen is known that predates 1790. One example was saved only because it was so large that the institution which stored it found it too heavy to conveniently remove. Even the founder of modern chemistry, Antoine Lavoisier, argued that stones cannot fall from the sky because there are no stones up there (p. 3). This eminently logical conclusion is based on everyday experience: I have never seen a stone in the sky nor have I known anyone who has. Yet today we acknowledge the existence of meteorites, "Stones that fall from the sky."

The author, a well known science writer, produced the controversial best seller *The Facts of Life: Shattering the Myth Darwinism* (1993) which effectively critiqued many aspects of the Darwinian paradigm. No creationist, he simply focused in this work on the intolerance of science and concludes the purge of fundamentalism in the West has affected the scientific community as well and that we are "living in a time of rising academic intolerance" (preface). This book is about scientists who are "willing to risk the censor and ridicule of their colleagues" by exploring phenomena which their peers have determined should not be explored (p. 5). It is also about scientific research into "taboo subjects: Subjects whose discussion is forbidden under pain of ridicule and ostracism" (p. 5). He even concludes that past scientists who braved intolerance, such as Faraday and Reichenbach, would "almost certainly have experienced *more* difficulty, not less, in making their voices heard in today's climate of intolerance" (p. 5). Some of Milton's many examples have been vindicated, such as heavier-than-air flight and meteorites. Others may never be proven, but, the author argues, they should nonetheless be explored.

Some prime examples are the "completely idiotic idea" that heavier-than-air machines can fly. The author notes that the experts were convinced of this on purely scientific grounds and rejected outright claims of flight "without troubling to examine the evidence" (p. 11). It took five years for the Wright brothers' claims to be accepted by academia-in spite of scores of public demonstrations, photographs and their persistent efforts to convince the world that they actually did what they claimed. One of the articles quoted contains a report ridiculing the Wright brothers alleged flying, and good reasons-seem logical even today-for not believing in human flight were articulated ("The Wright Aeroplane," 1906, p. 40).

Some of the reasons for this intolerance are laudatory, i.e., a desire not to be corrupted by the incredulous acceptance of wrong ideas which could mislead-nonetheless, researching even erroneous ideas can produce tangible scientific results. The author stresses that many famous controversies of the past, such as whether the sun is the center of the solar system, are interesting but not life threatening as are arguments about whether HIV or something else causes AIDS. The intolerance in the HIV research community is well documented, with some of the leading scientists ostracized because their views are judged not politically correct. Wrong ideas should be proved such, and tactics all too often taken to silence minority opinions should be deplored by academia. Milton's main concern is that billions are being spent on research to support theories of powerful scientists which are based on politically correct ideas, not empirically proved science.

Those in a position to make research a reality often simply refuse to examine the evidence. Milton cites the case of an engineer who built a ship twice as fast as those then in existence. Fruitless exchanges with the admiralty motivated the inventor to put his invention-the turbine engine-on public display, embarrassing the entire British fleet in front of the crowds, including Prince Edward and Queen Victoria. The illegal display was put on at quite a risk but was specularly successful, as the inventor no doubt expected. Even famous scientists such as Thomas Edison had to put on a large public demonstration before the scientific world would believe that his electric light worked. Then when he publicly demonstrated it, no scientists showed up because they believed his claims were contrary to the law of physics, and thus impossible. Why show up to see something that is impossible? Better to stay home and do something productive.

It is even difficult to do research in certain areas because of the power wielded by scientific orthodoxy to reject articles for publication and to refuse to fund certain projects. A prime example is the subject of evolutionary biology where the author notes in his country (Great Britain) "only the Darwinian mechanism of random mutation coupled with natural selection may be publicly discussed or taught in schools" (pp. 89-90), even though evidence exists for other mechanisms. He adds that "no science program has ever been shown or is ever likely to be shown on British television questioning any aspect of the Darwinian mechanism, because it is the *most strictly observed taboo subject"* (p. 90, my emphasis).

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The author then notes that evolution was debated on prime-time Soviet Educational Television on a station which broadcasts with such power that it can be heard from Finland to Japan. The author concludes "It is deeply disturbing to learn that such public debate of a taboo subject can take place in a so-recently totalitarian society, but is effectively forbidden in tolerant, liberal, democratic Britain and America" (p. 90). The problem is not over broadcasting controversial subjects because British stations relish broadcasting controversy to improve their ratings. Broadcasting *taboo science* subjects, though, usually does *not* engender superior ratings, and doing so may risk the station being "derided as mentally unbalanced or 'unreliable"' (p. 91). The author accurately concludes that once someone believes a conclusion is wrong, it tends to remain wrong in their mind regardless of new evidence--called the *devils' island* syndrome.

The solution the author recommends, is to establish a committee which acts as a scientific ombudsman and has the power to rectify cases where people "have been dismissed for non-scientific reasons" or whose papers have been censored or in other ways have suffered because of their ideas do not fit scientific orthodoxy (p. 100). This does not mean that clearly non-empirically-supported ideas will be exonerated, only that a group of unbiased observers (the main difficulty in this proposal) will have a chance to evaluate the ideas based on their merits. The difficulty of distinguishing what ideas are wrong from those that are merely taboo, although no easy task, is one that it is imperative to undertake.

In a chapter called *A Research Game,* Milton details some of the reasons why he believes certain ideas and areas are forbidden topics for research. This chapter eloquently applies to problems that theists experience in origins research. A major reason, Milton notes, is because of the "human tendency to see what we expect to see; what fits with our beliefs and our expectations. (p. 133). In short, the author eloquently argues that science, like religion, is a belief structure, and scientists must support this belief structure to achieve power and esteem in science.

Further, the scientific community has abandoned objectivity and has accepted the "stop at any cost" approach to topics that it deems violate or threaten its belief structure which is atheistic, materialistic, and reductionistic (p. 157). It is only when the intolerance of science is exposed that this self-defeating behavior can be stripped away to allow the facts to dictate conclusions, or at least admit that one's science worldview is a belief structure.

This reviewer would be inclined to ignore some of the examples Milton uses, but his point is proved if only 25 percent of his examples are valid. In short, the author concludes that there exist "major anomalous phenomena taking place that orthodox science is ignoring yet which are valid subjects of study, crying out for research, and in many cases promising radical revisions of our understanding of the nature of the world." (p. 233).

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The Wright Aeroplane and its fabled performance. 1906. *Scientific American* 44(2):40

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EUGENE F. CHAFFIN*

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A CHALLENGE TO A CLASSIC EXAMPLE OF THE SURVIVAL OF THE FITTEST DOCTRINE: THE DODO AND THE PASSENGER PIGEON STORY

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Received 19 October 1995; Revised 23 November 1996

Abstract

Careful re-evaluation of the Dodo by several contemporary researchers has found that many of the widely accepted conclusions about it are wrong. It was not a fat, slow, inferior, defenseless bird, but a swift and fierce fighter if it perceived that it was threatened. The common conclusion that it was defenseless is partly due to the fact that it did not have a natural fear of humans or many animals. Often given as the prime example of how evolution prunes out the weak, it was concluded that its extinction was not because of inferiority, but due to the wanton disregard of life by humans. Often regarded by contemporaries as a wonderful, magnificent creature, its loss proves not the efficacy of natural selection, but the depravity of its caretaker. In contrast the Passenger Pigeon was widely regarded as one of the most fit and evolutionarily successful birds; yet it became extinct. This case also eloquently illustrates the depravity of the Passenger Pigeon's caretaker.

Introduction

The classic example of evolution in action, the most widely known symbol of extinction, is the Dodo bird (Austin, 1961). The Dodo bird (*Raphus cucullatus*) is a member of the idae family, order Columbiformes, meaning a dove shaped bird. This non-flying, allegedly "obviously unfit" bird became extinct as evolution would expect, and it is used as a prime example of natural selection and proof of how evolution works (Livezey, 1993). The demise of the Dodo has become a fixture of our language, and a symbol of extinction. The term is often used to refer to something that is enormously inefficient or someone who is grossly incompetent or stupid. Examples such as auto safety expert Clarence Ditlow III's statement that if the American car industry does not build a better car, "they'll go the way of the Dodo bird" are common. From the animal has come such expressions as "dead as a Dodo" referring to something that is forever gone and very much a thing of the past (Evans, 1970; Terres, 1987). The term Dodo as applied to a person refers to one who is dumb, addled or looks silly.

They were once sketched, painted, and lampooned—just the right bird for Lewis Carroll's *Alice in Wonderland's* menagerie of off-beat animals. The Dodo that Alice met was "…faintly absurd...[and] spoke in words of many syllables" (Silverberg, 1967). The most famous reconstruction was done by the taxidermy studio of Roland Ward of London. It is now in the American Museum of Natural History Flying Bird Hall, located near a completely restored skeleton (Edwards, 1958). Illustrations and reconstructions often show it as a magnificently overweight pigeon-like bird which allegedly had a "large body and small wings, far too small to permit him to fly" (Funk, 1978, p.194).

The Dodo is probably not only the best known extinct modern species, but a prime exhibit of the efficacy of natural selection to prune out weak animals and those that fail to accommodate to changed conditions. Extinction thereby creates an ecological niche into which the "superior" animals can spread (Eldredge, 1991). In fact, the loss of the Dodo has not created an ecological niche, but has adversely affected other life. The endemic sapotaceous tree *Calvaria* is now nearly extinct because its seeds require passing "…through the digestive tract of the now extinct dodo, *Raphus cucullatus*, to overcome the persistent seed coat dormancy caused by a specially thickened endocarp" (Temple, 1977, p. 885)

Romer (1941; 1968, p. 223) has long argued that the Dodo was clear proof of the advantage of flight-showing that birds that lost the ability to fly were evolutionarily inferior, and were thus selected out. This seems contrary to the conclusion that selection evolved them to be flightless birds in the first place. It is also contradicted by the fact that these Dodo birds had no enemies, feared no creature and thus would not normally have flown away from "enemies" even if it could.

Williams concluded that the bird became extinct, not because it could not fly, but because it was stupid. Darwin predicted that the Falkand Island fox would soon be "…classed with the Dodo as an animal which has perished from the earth" (Williams, 1951, p. 8). Some scientists go even further, using evolution to justify or at least condone the extinction of the Dodo and other animals:

> Extinction is a natural process essential to evolution... man's role in it, and ethical implications...is a difficult subject for me to write about. Many conservationists will not like what I say. But the subject is evolution-related, and I have to treat it. Man's evolution, multipli-

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> cation, and occupation of the world have inevitably caused the extinction of many plants and animals, directly or indirectly. Man has hunted or is hunting many animals to extinction, either for food (for example, the Dodo on Mauritius, some of the giant tortoises on the Galapagos and probably the moas in New Zealand), for sport (for example, the Ostrich in Arabia), or in self-defense (for example, the Lion, which has been retreating before man for 2000 years). Current lists of extinct and vanished species include many more examples. But it has been man's role in changing the face of the earth that has caused the most massive extinctions (Darlington, 1988, p. 246).

Other scientists have argued that the Dodo was an evolutionary link that "was of considerable importance" (Brom and Prins, 1980, p. 236)

The Origin of the Dodo

The Dodo's origin can only be speculated and has been a subject of controversy for decades. The birds, which were once called "gentle Doves," Kitchener concluded "…probably evolved from African fruit pigeons of the genus *Treron* which became stranded on the blissfully predator-free island of Mauritius" (1993, p. 24). Whitlock speculated that they are related to pigeons or perhaps rails and are now usually classified among the pigeons (1981, p. 16). Study of its feathers, though, finds it has unique traits not found in "any other bird" (Brom and Prins, 1989). Dodo evolution is largely speculation due to a complete lack of transitional forms and no evidence yet of evolution in the fossil record (Livezey, 1993). Even the derivation of the name *Dodo* is in question. The word is Portuguese for simpleton, but the Portuguese did not remain on Mauritius island after discovering them, and evidently no references to Dodo birds have been located in Portuguese writings of the time; (Greenway, 1967, p 120). Others argue that the word Dodo is simply a rendering of its call, an onomatopoeia (Quammen, 1996)

The Dodo lived on the small island of Mauritius, 500 miles east of Madagascar in the Indian Ocean. Fortunately, many complete Dodo skeletons also exist, mostly assembled from bones found in the late 1800's. Of the solitaire Dodo, only a large number of bone fragments exist, and for the white Dodo, not even bones exist.

A careful recent examination of the Dodo has revealed that many of the common perceptions about the bird are probably incorrect (Hoffman, 1991). In the words of Maddox, "…the Dodo deserves a better press" (1993, p. 291). Specifically, recent studies, such as those by Livezey on almost 400 Dodo skeletal fragments and Kitchener at the Royal Museum of Scotland, have radically changed our view about the bird. This latter work has questioned the role of the bird in evolutionary history:

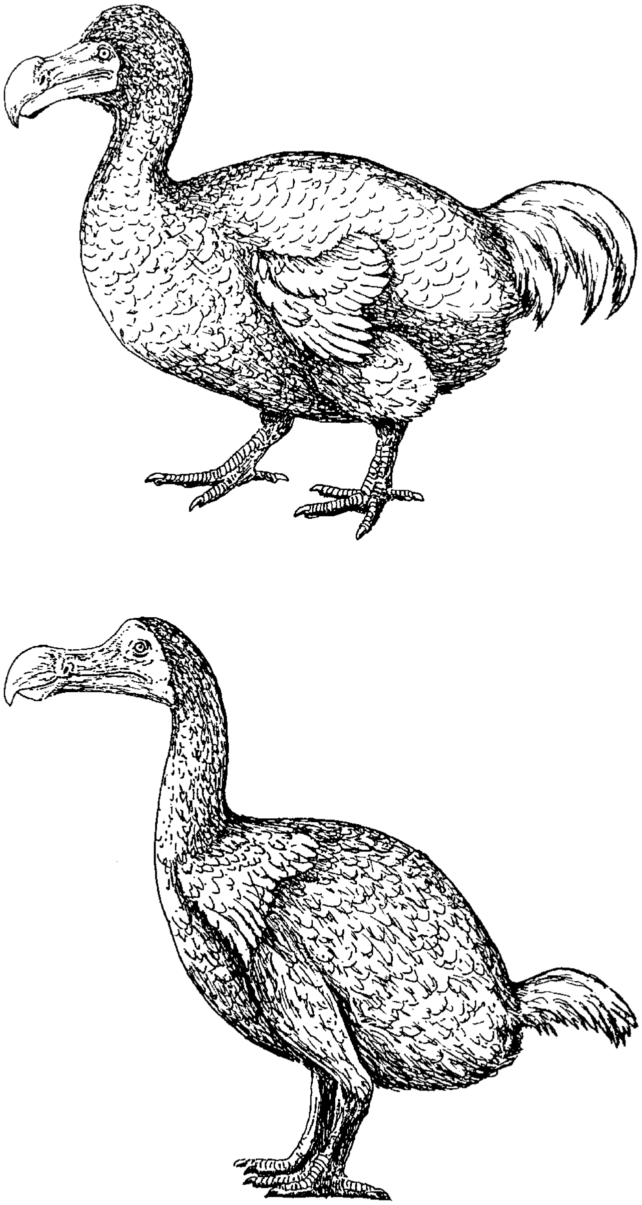

Figure 1. Artist's conceptions of the dodo bird, as it probably appeared in captivity (above) and in the wild (below). According to Kitchener (1993a), Dodos kept in captivity were fed a high fat diet and weighed more than they did in the wild. Illustration adapted by Rich Greer from an article by Paul Hoffman: "A New and Improved Dodo," ***Discover*** **12(4):16, April 1991.**

> Rivaling the dinosaurs as a symbol of extinction, the Dodo is renown for being slow, stupid and fat. An evolutionary disaster, *Raphus cucullatus* was doomed to extinction from the day it was discovered by hungry Dutch sailors in the forest of Mauritius in 1589. Wasn't it? Maybe not (Kitchener, 1993, p. 24).

Kitchener's work is based on detailed study of the bones and the dried head specimens. He has shown that the Dodo was much thinner arid sleeker than previously believed (Figure 1). Many of our modern conclusions about the Dodo's appearance were based on 17th century oil paintings of overweight, under-exercised birds—a condition which resulted from their being kept by wealthy Europeans who fed them a high fat diet (Kitchener, 1993a). Their pet Dodos ballooned up to almost double what they normally would have weighed in the wild. At their normal 30 pounds they were good sized birds, but not much heavier than a comparably-sized bird such as a swan.

Even minor details that gave the birds a "stupid" look, in harmony with their historical image, are being modified with our new understanding. We now realize that its tail, often shown as a sparse collection of feathers located rather high on the bird's back, was likely much fuller and far more dignified. The existing reconstructions, which Edwards (1958, p. 834) stated have caused the bird to look "sedately amusing" and produced "vast amusement" for observers, may now all have to be reexamined.

The Dodo species actually consisted of at least four similar flightless birds: The Dodo of Mauritius, the White Dodo, the Solitaire of Reunion (once called Baurbon), and the Rodriguez Solitaire that lived on tiny Rodriguez island. The Mauritius Dodo's bill was as long as nine inches and was prominently hooked downward at the tip. The beak and the area up to and behind the eyes lacked plumage, the feet and legs were yellow, and the skin was light ash in color. Further, as a 1634 account stated, their irises were a whitish color; their eyes were round, small, and bright as diamonds; and their covering was of the "finest downe" (quoted in Gosse, 1861, p. 75). The Dodos also ate "stones" which they used in their gizzards to crush food (Day, 1989, p. 32). Their diet included plants; most likely seeds, fruit, and foliage (Richards, 1991).

Mauritius, Reunion and Rodriguez are a group of volcanic upthrust islands located between Madagascar and Australia. These widely separated small neighboring islands—Mauritius is only 809 square miles in area—stand alone in a water wilderness thousands of miles from any neighboring island or land. The birds evidently thrived in their habitat on a set of islands collectively called the Mascarenes (Greenway, 1967). Like many small remote islands, the Mascarenes did not contain mammals and the only vertebrates were a few reptiles and many birds. The varieties of birds included parrots, crows, sparrows, owls, geese, ducks and doves (Day, 1989). Their isolated homeland contained no animal predators or human inhabitants for eons.

The Mauritius Dodos were discovered in 1507 by the Portuguese, and in a mere 174 years they became extinct. The enormous slaughter during this brief time decimated this very remarkable bird" which once "existed in considerable abundance" (Gosse, 1861, p. 74). Contemporary accounts claim that sailors killed as many as 50 large birds a day, and often about half were Dodos (Greenway, 1967).

In contrast to the evidence remaining about the Mauritius Dodo, the Solitaire of Reunion and the white Dodo are known only from osseous remains or written descriptions plus drawings made by contemporary travelers. The Reunion Solitaire had been extinct since the end of the 17th century and the Rodriguez Solitaire since the latter half of the 18th century. Since the drawings were completed from live specimens, and travelers' accounts substantially agree on its physical traits, a good understanding of this species.' physiology can now be determined. The major differences in descriptions of the Solitaire pertain to its color, which probably reflect actual color variations in the wild. The Rodriguez Solitaire was, in contrast to the Dodo, "delightfully beautiful" and also "delightfully edible" (Day, 1989, p. 28).

The Myth of the Dodo's Obesity

The bird's obesity, slowness, and lack of flight and intelligence are all commonly given as reasons for its alleged evolutionary inferiority (Darlington, 1980). Dodos were believed to be not just large, but grossly overweight to the point that they could not fly and consequently lost this ability for the reason that they could not escape from their ground enemies. Kitchener, though, in studying their history, found that the *earliest* Dodo drawings showed rather thin birds—and only those paintings completed later display the familiar pudgy variety (1993). Over 12 original pictures (both drawings and paintings) of the Dodo now exist (Ley, 1948, p. 230). Kitchener further found that while the thin Dodos were drawn by those who had actually visited Mauritius, the plump portraits were produced mostly by artists working in Europe. This factor has led to speculation that Dodos brought to Europe were fattened by their owners.

Kitchener next evaluated the hundreds of Dodo bones that have been unearthed. Using the methods developed by criminologists and archeologists to reconstruct flesh on bones, he was able to determine that the skeletal pattern produced a bird "remarkably similar" to the early drawings of the Dodo; i.e. thinner, far less obese birds. Kitchener (1993a) concluded from his work that the actual weight of the wild Dodo was probably between 12 and 16 kilograms. This is close to the weight of a male great bustard, the heaviest flying bird alive today. Even an obese Dodo, Kitchener estimated, would weigh only 21.7 to 27.8 kg. This number compares closely with the only published record of a Dodo body weight that he could locate, a 1634 estimate of 23 kg. (50 lbs.) which may represent the upper limit.

Relying upon research with living birds which demonstrated that a bird's skeleton accounts for a fixed proportion of its body weight, Kitchener estimated a value of just under 12 kg. He concluded that although this value may be an underestimate, it still supports the smaller values. These estimates held up even when he compared bone-body weight ratios of flying and non-flying birds, such as that of a flightless kakapo, the world's largest parrot.

An evaluation of egg shells also can produce a body weight index because the mass of the eggshell varies in proportion to the mass of the bird that lays it. No known surviving Dodo bird egg exists, but from descriptions of their eggs in the literature, Kitchener was able to estimate the Dodo's weight at about 13.7 kg—the same value that he obtained from an analysis of the relationship between the length of the leg bone and other bone measurements (Kitchener, 1993a). The leg bone analysis method is based on a direct relationship between leg bones and the weight that they must carry, a relationship that holds for every size of bird from a hummingbird to an ostrich (Kitchener, 1993, p. 26).

Kitchener thus concluded that "…according to four different methods, all based on the Dodo's bones, the famous flightless pigeon weighed between 10.6 and 17.5 kg" (1993, p. 26). Further evaluation of the cantilever strength of leg bones produced a relationship which can be used to determine the running abilities of different size animals. This method provided evidence that they were indeed "swift of foot"—a conclusion which corresponds with eyewitness accounts stating that the Dodo "could run very fast" (quoted in Kitchener, 1993, p. 296).

While his analysis is not without problems, it has produced very reasonable conclusion, especially in view of the fact that the opposite thesis has little empirical evidence in its favor. Since Kitchener's first evaluation, original unpublished Dodo drawings from the early 1600's were rediscovered in a Hague, Netherlands museum, supporting Kitchener's earlier conclusions. The Dodos in the drawings are thinner than those in European paintings, and the femur design was tilted downward, reducing the bending forces on it and allowing it to shift its center of gravity (1993 a, p. 297-299). This evidence demonstrates that the Dodo was an effective, fast runner Kitchener concluded that

> …for more than 350 years the Dodo has been thoroughly misrepresented as plump and immobile. The reality is, however, that in the forests of Mauritius it was lithe and active. Like other Mauritian birds it would have undergone a seasonal fat cycle to overcome shortages of food, but never to the extent that those wonderful oil paintings suggest (1993, p. 27).

Several other studies have also confirmed Kitchener's results. Livezey (1993), in a study of 387 skeletal elements, concluded that the body mass of the Dodo was 21 kg for males and 17 kg for females. And Lindstedt and Calder (1976) estimated 15 kg for the Dodo and 17 kg for the solitaire. A problem in obtaining weight estimates is that the Dodo exhibited great seasonal variation in deposition of body fat and considerable intrageneric and intergeneric diversity in body mass (Livezey, 1993, p 262, 281).

The History of Mankind's Treatment of the Dodos

The earliest accounts of the Dodos date from 1598 and the Dutch navigator, Admiral Jacob Comeliszoon van Neck. The Dodos were found on an island he named Mauritius in honor of his patron, Prince Maurice of Nassau, ruler of the Netherlands (Panati, 1989, p. 202). Since Arab ships sailed the Indian Ocean as early as the middle ages, it is quite likely that they were aware of the bird, but left no known written records. The three islands on which Dodos lived, Mauritius, Reunion, and Rodriguez, lacked names then, or had names which we have not yet identified today.

The admiral reported that the island had abundant ebony tree forests and exotic wildlife which he described extensively. He also discussed in some detail the Dodos. He claimed that they were quite unlike any other bird with which he was familiar. Having no predators, the birds did not fear humans. when the soldiers looked through low lying nests for chicks, though, the birds pecked "mighty hard" (Panati, 1989, p. 202). They also could bite hard with their "remarkably strong" bill, and run fast with their strong legs (Brom and Prins, 1980, p. 233; Ley, 1948, p. 232). The crew killed many of the birds and soon found that, although their flesh was tough and bitter, the longer they were cooked, the more palatable their flesh became. They also took home a pair of adults, one of which ended up in the Netherlands. The birds were a sensation in Europe and were described in a fair amount of detail in numerous contemporary accounts. These records were critical in Kitchener's reassessment of the bird.

Emperor Rudolph of Germany also purchased one, and soon had its portrait painted in oils. Pictures of the birds rapidly circulated throughout Europe, and the demand for them was so great that ships soon began bringing them back to Europe for sale to the wealthy or to naturalists (Panati, 1989, p. 202). They were evidently also shipped to India, Java and Japan (Brom and Prins, 1989). Many Dodos died en-route, and only about 12 reached Europe alive before they became extinct (Silverberg, 1967, p. 30). The original Netherlands bird was honored with 14 oil and watercolor portraits before it died. Further, the Dodos were excellent subjects for portraits-once posed, they remained virtually motionless until the picture was completed.

Unfortunately, these paintings cannot be relied upon exclusively because artists at times took "considerable anatomical license," some making the birds' hooked beak "more fearsome" and turning "their forked dove-like feet into the webbed toes of a duck" (Panati, 1989, p. 202). Nonetheless, enough paintings exist to provide clear evidence to help us piece together a picture of them.

The Last Survivors

Since the birds were easy to capture, within a short time the Dutch colonists along with sailors and visitors soon consumed most of the Dodo population. The animals that they brought with them, especially dogs, cats, monkeys', farm hogs, and the inevitable rat, ate the fledglings and broke the Dodo eggs open to consume the yolks. By 1681 the Mauritius Dodo was extinct, and the white Dodo became extinct in 1770. Rather than demonstrate their weakness, the history of the Dodos effectively argues for the gross irresponsibility and even viciousness of their caretakers (Quammen, 1996). Actually, despite the unceasing slaughter of wildlife carried out "by the hundreds of European ships that visited Mauritius, the Dodo survived for generations" (Day, 1989, p. 28).

It was only when the colonists "displayed a grim dedication to the cause of exterminating the Dodo" that their demise was sealed. According to Panati "not a single naturalist had attempted to mate any of the captive Dodos; they left no descendants" (1989, p. 203). The sailors would arrive at the island, not caring if a breeding stock remained because most were not animal connoisseurs, and few had any plans to return anyway. Even if a ship crew insured that breeding stock remained, the next shipload of sailors would nullify their forethought. Further, many persons then did not consider the total extinction of any animal type a possibility (Whitlock, 1981, p. 118). Most sailors were confined to meager rations on the ship, and no doubt relished their sojourn to a set of islands that contained much fresh meat (Day, 1989).

The last bird in England was stuffed by English naturalist John Tradescant. When Tradescant died in 1662, his entire nature collection was bequeathed to an acquaintance, Elias Ashmole (Brom and Prins, 1980). Due to his irresponsibility and the poor methods of preparing bird skins then, the entire collection's condition greatly deteriorated, and he donated the bird to Oxford University in 1683-two years after the last living Dodo was seen on Mauritius. Even Oxford did not take very good care of the bird-and except for the head and foot which was saved by a foresighted curator, it was burned as trash in 1755 (Panati, 1989, p. 203). Evidently the museum's board of directors "...took one look at the dusty, stupid-looking bird and unanimously voted to discard it" (Wallechinsky and Wallace, 1981, p. 361).

The intrigue over the bird was such that by 1800 ". . .professional naturalists were casting doubt on written descriptions of the bird, as well as on extant drawings." It even became "scientific vogue to deny the bird's existence and to challenge the Oxford head and foot as fakes" (Panati, 1989, p. 203). If it was a genuine bird, the critics reasoned, certainly there would have been extensive systematic efforts to preserve it-at least a good skeleton. A group of zoologists searched Mauritius in 1850 looking for bones-and found none. Soon the Dodo was denounced as a "scientific fraud" (Panati, 1989, p. 203).

Evidence for its existence did not surface until a resident of Mauritius, George Clark, extensively searched the island and eventually discovered numerous scattered bones. His specimens were soon shipped to major museums, and after extensive study they were pronounced authentic. These researchers later attempted to assemble the bone fragments-many in poor condition-into complete Dodo skeletons. They are now recognized as real animals, but the many other myths surrounding them have died slowly. And these myths have unfortunately developed largely to support the theme of evolutionary naturalism (Darlington, 1980). Now that the bird has been extensively studied, we realize it did not support the myth, but eloquently supported the condition of humankind (Whitlock, 1981). We also now know that the bird is much more of a testament of human callousness than evidence for evolution. Not only did the Dodo became extinct on these Mascarene Islands, but Day (1989) claimed that "countless pathetic slaughters wiped out tortoises, gray parrots, blue pigeons and many other birds and reptiles" that once thrived there in peace.

Kitchener argued that it was *not* the Dodo's physical inferiority which caused its extinction, but the "Rats, pigs, and monkeys which arrived with the sailors and pillaged the Dodo's vulnerable ground nests" (1993 p. 24). Smith concluded it became extinct not because of natural selection but ". . .direct predation-as is true of probably all recent cases of extinction by man" (1966, p. 271). Extensive study of the extinction problem by Raup (1991) showed that a number of similar factors were unfortunately responsible for almost all historical extinctions. Even birds which have a reputation quite dramatically opposed to the Dodo's, such as the Bald Eagle, have been threatened with extinction for somewhat similar reasons. All animals that lay eggs near the ground surface are vulnerable, which is why so many birds have become extinct in modern times. Island birds are especially vulnerable. Of the 171 species of birds known to have become extinct, fully 155 lived and died on islands (Quammen, 1996, p. 262) The false image of the Dodo as a fat, slow, inferior defenseless bird seems to argue for evolution far more effectively than similarly threatened better adapted birds such as the Bald Eagle, the latter which was saved only through deliberate efforts of a large number of concerned individuals. The story of the Passenger Pigeon *(Ectopistes migratorius)* is also an instructive case history in natural selection and evolution.

The Passenger Pigeon

The Passenger Pigeon, which no one claims was an inferior bird, once numbered over 20 billion strong. It was the most abundant bird in America and accounted for over one-quarter of all land birds (Blockstein and Tordoff, 1985). Obviously evolutionarily successful, it also became extinct by the 20th century due to human wanton destruction and greed (Dennis, 1993; Buscemi, 1978). The last one died on September 1,1914, in a Cincinnati, Ohio Zoo (Eckert, 1965). Their decline was rapid, and occurred first in the East, then in the Midwest. It happened at the hands of a mere “1,000 professional pigeoners” (Blockstein and Tordoff, 1985, p. 849). From billions to 1/4 million in 1896, the last one in the wild was shot on March 24, 1900, in Pike County, Ohio. Their story is tragic:

> As late as 1860 any naturalist or layman might easily have argued that the Passenger Pigeon was, in biological terms, the most successful species of bird on earth. Its numbers were so great, its territories so vast, and its strong body so well designed for its needs and habitat, that it is almost incredible that it could have been exterminated within the short space of 50 years ....in the autumn of 1813, that most famous of ornithologists and illustrators, James Audubon, was traveling in a wagon...when a column of Passenger Pigeons filled the sky so the ‘light of noonday sun was obscured as by an eclipse.‘...For three days other flocks followed this first one (Day, 1989, p. 34-35).

Audubon calculated the size of only one of the bird columns, which was one mile wide and passed overhead for three hours at a speed he estimated at 60 miles per hour. He concluded that over a billion birds were in this flock which would consume over eight million bushels of feed a day. The Passenger Pigeon seemed to be one of the last birds to go extinct for other reasons:

> Passenger Pigeons were strong and swift flyers. They maintained constant speeds of more than 96km (60 miles) per hour, and were capable of flying 1600km (1000 miles) in a day. Thus ...they seemed always capable of finding sufficient food because of their ability to range so widely in a matter of days... It has been well established that these birds look after and take care of all orphan squabs whose parents have been killed or are missing. These birds are long-lived, having been known to live 25 years caged. (Audubon quoted in Day, 1989, p. 34-35).

The traits of the Dodo bird provide a plausible reason for their extinction, but for the Passenger Pigeon, as Blockstein and Tordoff note, “...although there has been much speculation about the extinction of the Passenger Pigeon since that time, most of the proposed explanations are inadequate” (1985, p. 485). The story of their demise is, as Day states, a testament of human greed because it seems inconceivable that a bird as numerous as the Passenger Pigeon could have been exterminated so rapidly.

> ...Sportsmen who indulged in trapshooting bought up perhaps a million birds a year.... nearly all of which would die either by being shot or having their wings or necks broken by being hurled from the catapult traps.... With the advent of the telegraph and the railroad, hunters were able to follow and slaughter the migrating birds wherever they landed. From then on nesting grounds were seldom safe. The birds were searched out, harried and destroyed. Hundreds of railway boxcars were sent with the hunters and waited to be filled with the carcasses. By 1896 there were only 250,000 Passenger Pigeons left. They came together in one last great nesting flock in April of that year...in the forest on Green River near Mammoth Cave. The telegraph lines notified the hunters and the railways brought them in from all parts. The result was devastating-200,000 carcasses were taken, another 40,000 were mutilated and wasted.... The entire kill of this hunt was to be shipped in boxcars to markets ... but there was a derailment...The dead birds packed in the boxcars soon began to putrefy...the rotting carcasses of all 200,000 birds were dumped into a deep ravine a few miles from the railway loading depot (Day, 1989, p. 36-37).

The birds were killed not just for food, but to feed to hogs, even for fertilizer (Hilton, 1987). The level of the hunter’s greed was vividly revealed by Johnson as follows:

> Toward the middle of the nesting site sounded the constant ring of axes chopping down trees loaded with

> nests. Duller sounds were made by other men hitting saplings with sledge hammers to shake the squabs out of the nests with sticks. Many of the young birds were so heavy that their bodies broke open when they hit the ground. As the hunters scurried about each downed tree they grabbed the squabs, jerked off their heads, and threw them on the bloody pile of birds near the wagon-loading point. It made little difference here that pigeon blood splattered the bushes and made stinking little pools in the wagon ruts. The instinct of self-preservation in the passengers was subdued by the one which said that their young must be protected! Setting passengers hovered nervously over squirming young and watched the slaughter... The destruction went on for months. At this one nesting site it began in March and continued until August. The only thing that could stop it would be the disappearance of the passengers or a drastic drop in the market price of the birds (1956, p. 85).

Although important, "Overhunting did not exterminate the Passenger Pigeon, as is commonly believed; rather, over two decades, cohorts died without the opportunity to replace themselves" (Blockstein and Tordoff, p. 485). So rapid was their extinction that scientists searched for years to confirm that indeed every last one had died (Hodge, 1912). The major cause of this was:

> ...the relentless disruption of the nesting colonies, which resulted in repeated nesting failures. This was facilitated by the development of the eastern railroad network and the telegraph which made every colony accessible to market harvesting. Instead, Passenger Pigeons became extinct because over a period of about 20 years-twice an individual's lifetime-adults were prevented from replacing themselves, directly by the nestling harvest and indirectly by the shooting, which led to nest abandonment. Had reproduction continued, it is unlikely that netters and shooters away from the nesting sites could have exterminated the Passenger Pigeons. There were simply too many pigeons for the harvest of adults to be complete. (Blockstein and Tordoff, 1985, p. 450-485).

The success of the passengers was not due to lack of enemies. They could protect themselves by traveling and nesting in large groups so that most pigeons were effectively shielded from predators, a method called predator satiation. Wherever the pigeons went, there were not enough local predators to seriously detract from their numbers. The pigeon had numerous enemies, aside from man, but there is no reason to believe that they had a material effect on the population. (Schorger, 1955, p. 208). Actually, the Passenger Pigeon was a major source of food for many animals, including the mink, goshawks, wolves, foxes, lynxes, cougars, bears, raccoons, opossums, pole-cats, eagles, and even vultures.

Summary

Some may argue that the humans won and the Dodos lost in the struggle for life. Darwin and the developers of natural selection, since his 1859 *Origin of Species* classic, have defined natural selection in terms of competition between animals for food or mates. The superior, in terms of its ability to gather food and escape enemies, would eventually become dominant and the other animals would become extinct. The Dodo and Passenger Pigeons did not become extinct because humans were competing with them for the same food supply. They became extinct because of greed, carelessness and the contingencies of history (McKinley, 1960).

Human caused animal extinction most always have little to do with direct competition for food, and extinction in the long run causes loss of food supplies and resources for humans. Humans now have the ability to cause most all life to become extinct by virtue of their knowledge of such tools as poisons, guns, and atomic power. It has nothing to do with survival of the fittest or natural selection in the Darwinian sense. Eldredge (1991, p. 205) stated that "...predators generally do not hunt their prey into oblivion," but humans regularly do. Humans are increasingly taking over land that once was dominated by animals, but as ecologists stress, this need not cause the extinction of animals. Only if larger numbers of humans wantonly disregard the welfare of the animals living in an area and refuse cooperation with conservationists would this happen. Selfishness, short sightedness, greed, and lack of planning have caused most recent animal extinctions, not direct human competition with animals in the Darwinian sense. This is supported by the fact that "very many of our game birds, shore birds, and waterfowl, would today be extinct, or near extinction, were it not for coddling through refuges and protective laws" (Babuet, 1990; Schorger, 1955, p. 215). The story of two birds, the Dodo which appeared to be inferior and the Passenger Pigeon which was clearly superior as judged by the evolutionary naturalists of the day, helps us to better assess the role of natural selection in history. Its role seems to be primarily to reduce the rate of harmful mutation accumulation, often call de-evolution, and not the role that Darwin ascribed to it. The Dodo and the Passenger Pigeon example also support Raup's (1991) conclusion from his extensive study of the cause of extinction, namely that bad luck is by far more important than bad genes. Animals that have become extinct are not in any clear way inferior to those still around today but were the victim of circumstances and chance.

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Errata

All of these are in CRSQ, vol. 33, March, 1997.

p. 234 (inside front cover), the letter *Animal Death and the Curse* was not printed in that issue.

p. 242, right column, line 14, delete the entire sentence beginning "In other words . . . the region now."

The author's address has changed to D. Ashley Robinson, 665 Idlewild Circle, Apt. B10, Birmingham, AL 35205, email: daro@aol.com.

p. 264, the "western banded gecko" is misspelled, line 1, left column.

p. 267, the y-axis in Figure 6A was missing the number 10. Also, the x- and y-axes in Figure 7 were supposed to be scaled by a factor of 10 making it comparable to Figures 5 and 6.

p. 268, left column, line 12, references Wise 1970 should read Wise 1990. Also, page 268, left column, line 16, references Figure 2 which should be Figure 8. The word "chimpanzee" is misspelled in the title of Table III on that same page.

p. 269, line 13 of the right column, the word "Proganochelyidae" is misspelled in the quote. Figures 10a and 10b are sometimes referred to as 10A and 10B when there should be no distinction between capital and lower case letters a and b.

The managing editor apologizes to Mr. D. Ashley Robinson for these errors.

INVESTIGATION OF A NON-CARBON BASED BIOCHEMISTRY AND ITS IMPLICATIONS FOR CELLULAR BIOLOGY

PART I. GLYCINE AND ITS SILICON BASED DERIVATIVES

Edward A. Boudreaux*

Received 12 August 1996; Revised 2 December 1996

Abstract

It has been suggested that since the presumed biochemical evolution of life involves the formation of proteins from amino acids, a similar mechanism could perhaps have also occurred with non-carbon based amino acids. The element most chemically similar to carbon is silicon, although no silicon analogs of amino acids are known to exist. This paper reports a study of bond energetics for glycine, a hypothetical analog in which carbon atoms are replaced by silicon, and other modifications in which the glycine nitrogen and oxygen atoms are replaced by phosphorus and sulphur respectively. Comparison of energy changes are made between reactant molecules and their respective peptide bonded products. The results indicate that the peptide bond formation process is energetically feasible for glycine, but not for the proposed modifications.

Background and Introduction

While efforts to validate the creation mode of origins have embarked upon the vistas of most all areas of science, the one receiving the least attention is that of chemistry. The evolutionary supposition of a "prebiotic soup" has been addressed. Classic experiments of Fox, Orgel, Miller and others have demonstrated that a properly energized, reducing atmosphere of CH_4 , NH_3, H_20, and H_2 can produce certain amino acids (Fox, 1976; Miller and Orgel, 1974; Miller, 1974). However, no polypeptides resembling natural proteins have been produced under laboratory simulations of "prehistoric" conditions (Orgel, 1973, pp. 189-fq; Yockey, 1981; Oro and Kimball, 1961).**

All five of the nucleotide bases have been synthesized by reacting either various combinations of HCN in aqueous solutions, or certain nitriles, including urea and other essential components under controlled heating (Ponnamperuma, 1965; Sanchez, Ferris, and Orgel, 1966; Fox and Harada, 1961; Stephan-Sherwood, Oro, and, Kimball, 1971).

The sugars ribose and deoxyribose have been prepared from alkaline solutions of formaldehyde (Ora and Cox, 1962). Nonetheless, all attempts to combine these compounds together with phosphoric acid or phosphates to produce DNA-like polymers have failed to yield products resembling true biochemically functional polynucleotides. However, Westheimer (1987) still contends that the uniqueness of phosphates in polynucleotides is a choice, of nature dictated by the evolutionary process. Miller (1992) has reviewed the current state of affairs in the theory of biochemical evolution. The available data offer no more supporting evidence than what has been presented in the course of the past 45 years or so.

Creationists and evolutionists alike agree that the basis for the formation of biomolecules is rooted in the uniqueness of the chemistry displayed by the element carbon. This is the only element demonstrating a virtually unlimited capacity for "catenation" (i.e., the property of like atoms bonding to each other and to other kinds of atoms at the same time). In spite of this fact, many non-creationists still make allusions to a parallel biochemistry based on some element other than carbon. Admittedly most of these contentions are usually expressed in rather nebulous terms with little or no concrete substantiating evidence offered in support. However, there is a serious belief on the part of some respected evolutionists that, given appropriate conditions, some other element could replace carbon in its biomolecular function. Ponnamperuma and Woese (Begley, 1979) stated that the large amount of silicates present in clay may have played a major role in the origin of biochemistry when the earth was initially formed (see also Woese, 1979). This was initiated by Bernal (1967) and reiterated more recently in the work of Cairns-Smith (l982).

Consider the following case in point taken from a recent interview made by Frank Miele with Richard Dawkins (Miele, 1995);

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**The subjects of chemical evolution and design in chemical compounds have appeared in the Quarterly previously. See the following selected bibliography: Williams, E. L. 1967. The evolution of complex organic compounds from simpler chemical compounds: Is it thermodynamically and kinetically possible\?: *CRSQ* 4:30-35; Gish, D. T. 1970. The nature of speculations concerning the origin of life. *CRSQ* 7:42-45, 83; Brauer, D. L. 1971. Organic chemistry reflects God's infinite knowledge. *CRSQ* 8:9-12; Coppedge, J. F. 1971. Probability and left-handed molecules. *CRSQ* 8:163-174; Gish, D. T. 1972. Book review of Biochemical predestination. *CRSQ* 8:277-280; White, A. J. 1972. Uniformitarianism, probability and evolution. *CRSQ* 9:32-37; Gish, D. T. 1979. A consistent Christian-scientific view of the origin of life. *CRSQ* 15:185-203; Trop, M. 1979. Polyamino acid—the missing link. *CRSQ* 15:205-209; Moore, J. N. 1985. Teaching about origin questions: Origin of life on earth. *CRSQ* 22:20-25; Mini-Symposium—Creationist interpretations of chemical organization in time and space. *CRSQ* 22:157-158; Heyes, G. B. 1986. Stereochemical design in lipids. *CRSQ* 23:20-27; Anderson, K. L. 1989. Prebiotic formation on the first cell. *CRSQ* 26:55-60; Lumsden, R. D. 1993. Sources and applications of botanical alkaloids offer evidence of creative purpose and design. *CRSQ* 30:132-140.

Q. Does the existence here on earth of an alternative metabolic "fuel," in some sense make it more probable that there could be life elsewhere in the universe, perhaps using a different base than carbon?

A. (Dawkins) That's surely got to be right, hasn't it? You can speculate in a science fiction way about alternative biochemistry of life, but if you couldn't find anything on Earth moving ever so slightly towards an alternative biochemistry, that would argue against the idea. But when you do find an alternative biochemistry for life here on Earth, that makes it more plausible that somewhere else in the universe there's got to be an alternative form of life.

Q. What then is the *sine qua non* of life? What raw materials and conditions are necessary for life to exist?

A. (Dawkins) Well, you need raw materials that can self replicate. I would have to be more of a chemist than I am to know how likely it is that you are going to get such molecules. I should very much like to direct chemists toward devising an alternative hypothetical chemistry that supports self-replication, a whole alternative system that could, in principle, give rise to life. The fundamental principle that will be required is self-replication. Chemists have begun to look at autocatalytic functions in chemistry where at least some of the prerequisites are present. The *sine qua non*, as you say, is self-replication. I don't know how difficult it would be to achieve that chemically.

Of course, no one knows (except God) what conditions are actually necessary for life to be imparted to a system composed of biomolecules assembled within a cellular matrix. Dawkin's reply to this question specifically addresses the biochemical process of replication involved in cellular reproduction and related processes. Before one can even consider the requirement of "self-replication" in any assumed alternative "biochemistry of life," there is the primary consideration of producing the essential molecular components for constructing protein, RNA- and DNA-like structures. In effect, all carbon atoms in amines, ribose, and nucleotide bases would have to be replaced by some other substituent atom.

The challenge of identifying a viable alternative model chemistry that supports self-replication is the basis for this paper.

Statement of The Problem

The first and most extensive phase of this study has been to investigate the chemical characteristics of various hypothetical amino acid-like molecules, in which the carbon atoms have been substituted by some other chemically similar atoms. The single candidate most likely to chemically mimic carbon is the element silicon (Si), positioned just below carbon in the same Group of Periodic Table of Elements. The Si atom forms a maximum of four chemical bonds as does the C atom, and Si exhibits at least some limited :catenation" ability. A portion of the Periodic Table depicting the pertinent elements relating to this problem is presented in Table I.

The proposed Si substitution will have to be considered in all 20 amino acids crucial to protein structures. I will refer to these hypothetical pseudo-amino acids as "silicino acids." However, the C-N bonds in natural amino acids are chemically different from Si-N bonds in silicino acids. Thus, the replacement of N by phosphorus, which is adjacent to Si in the Periodic Table (see Table I), just as N is adjacent to C, is a logical consideration. It may be that Si-P bonds in silicino acids will have a chemical similarity to the C-N bonds in amino acids.

An additional consideration is the comparison of C=O and C-OH bonds in the carbonyl functional groups of amino acids, to analogous Si=0 and Si-OH bonds in silicino acids. It is anticipated that replacing oxygen by sulfur to yield Si=S and Si-SH bonds, may be preferable counterparts to C=O and C-OH bonds in the acid functional group.

Table I. Second and third period elements of main groups IV, V, VI.

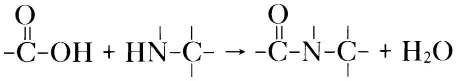
IV	V	VI	
C	N	O	(4 valence electrons – 2s and 2p orbitals)
Si	P	S	(4 valence electrons – 3s and 3p orbitals)

It will be necessary to characterize the structural features and chemical bonding of the silicino acids and compare them to similar properties of amino acids. The current understanding of silicon chemistry suggests that chemical characteristics of silicino acids will be significantly different from amino acids. This work is to demonstrate that these hypothetical biochemical molecular units do not vindicate the evolutionists' supposition of a non-carbon chemistry of life. On the contrary, biochemistry does require the specificity of carbon atoms to provide the necessary biochemical structures and functions. This, however, must be validated with the empirical scientific data presented below.

Format of The Study

Ten different species of the 20 essential amino acids have been selected from among those contained in the protein insulin. This example was selected because the polymer chains in the primary structure are relatively short, and they incorporate a representative variety of amino acid peptide linkages. These amino acids, presented in Table II, are regarded to be retained in their L-optical isometric conformations (right handed) which are the forms occurring in most natural proteins. With ten per cent parent amino acids and the three modifications of silicino acids for each, there will be a total of 40 molecules to investigate.

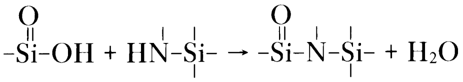
The major points of interest here are the processes of forming peptide and pseudo-peptide bonds. All known peptide bonds involve the process:



$$-\overset{\overset{O}{\|}}{C}-OH + H\overset{|}{N}-\underset{|}{\overset{|}{C}}- \rightarrow -\overset{\overset{O}{\|}}{C}-\overset{|}{N}-\underset{|}{\overset{|}{C}}- + H_2O$$

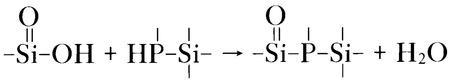
In the case of silicino acids, the parallel processes become:

Modification #1



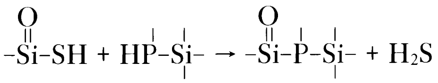
$$-\overset{\overset{O}{\|}}{Si}-OH + H\overset{|}{N}-\underset{|}{\overset{|}{Si}}- \rightarrow -\overset{\overset{O}{\|}}{Si}-\overset{|}{N}-\underset{|}{\overset{|}{Si}}- + H_2O$$

Modification #2



$$-\overset{\overset{O}{\|}}{Si}-OH + H\overset{|}{P}-\underset{|}{\overset{|}{Si}}- \rightarrow -\overset{\overset{O}{\|}}{Si}-\overset{|}{P}-\underset{|}{\overset{|}{Si}}- + H_2O$$

Modification #3



$$-\overset{\overset{O}{\|}}{Si}-SH + H\overset{|}{P}-\underset{|}{\overset{|}{Si}}- \rightarrow -\overset{\overset{O}{\|}}{Si}-\overset{|}{P}-\underset{|}{\overset{|}{Si}}- + H_2S$$

This study compares the energies of the amino acid C-OH bonds and the amino H-N bonds with the energies of the resulting peptide C-N-C bonds vs. H-N bonds vs. Si-N-Si bonds; Si-OH bonds vs. H-P vs. Si-P-Si bonds; and Si-SH bonds vs. H-P bonds vs. Si-P-Si bonds.

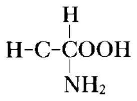
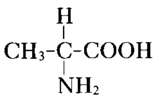
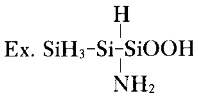
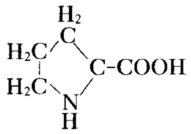
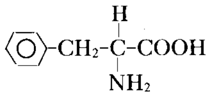
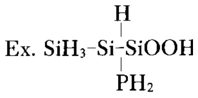
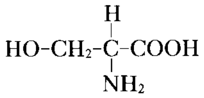
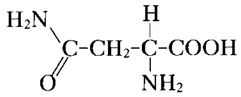
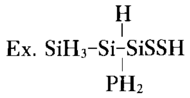
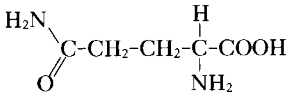
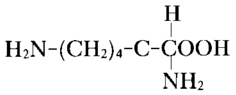
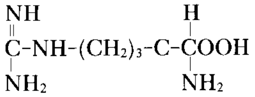
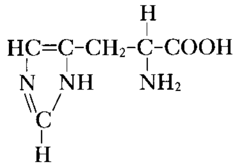
The final portion of this investigation deferred for a subsequent paper, is to calculate the bond energies of the six amino acid segments in the tripeptide portion of the primary structure of insulin, to wit;

Gly–Gln–Arg–Gly–Phe–Phe

A similar calculation will also be carried out with the most stable substituted forms of silicino acids whose structures are analogous to their Gly, Gln, Arg, and Phe counterparts. Thus the relative stabilities of peptide structures derived from natural amino acids can be compared with the pseudo-peptides derived from silicino acids. As inferred from this work, the binding energies of the latter systems are likely to be either too high or too low, in comparison to those of natural peptides, to be biochemically functional.

In this initial paper the data obtained for glycine and the three modifications of its silicino acid counterparts are presented. Subsequent publications will include data for all the cases cited above.

Table II. Select Amino Acids and Presumed Silicino Acids.

Amino Acids		
Glycine (Gly)	 $H-\underset{NH_2}{\overset{H}{C}}-COOH$	*Modification 1:* All C atoms replaced by Si atoms
Alanine (Ala)	 $CH_3-\underset{NH_2}{\overset{H}{C}}-COOH$	 Ex. $SiH_3-\underset{NH_2}{\overset{H}{Si}}-SiOOH$
Proline (Pro)		*Modification 2:* All C atoms replaced by Si atoms; all N atms replaced by P atoms
Phenylalanine (Phe)		 Ex. $SiH_3-\underset{PH_2}{\overset{H}{Si}}-SiOOH$
Serine (Ser)	 $HO-CH_2-\underset{NH_2}{\overset{H}{C}}-COOH$	*Modification 3:* All C atoms replaced by Si atoms; all N atoms replaced by P atoms; all O atoms replaced by S atoms
Asparagine (Asn)	 $H_2N-\overset{\overset{O}{\|}}{C}-CH_2-\underset{NH_2}{\overset{H}{C}}-COOH$	 Ex. $SiH_3-\underset{PH_2}{\overset{H}{Si}}-SiSSH$
Glutamine (Gln)	 $H_2N-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-\underset{NH_2}{\overset{H}{C}}-COOH$	
Lysine (Lys)	 $H_2N-(CH_2)_4-\underset{NH_2}{\overset{H}{C}}-COOH$	
Arginine (Arg)	 $\underset{NH_2}{\overset{\overset{NH}{\|}}{C}}-NH-(CH_2)_3-\underset{NH_2}{\overset{H}{C}}-COOH$	
Histidine (His)		

Method or Investigation

Since all of the Si modifications to the amino acids are hypothetical, any laboratory synthesis approach to the study of this problem is not feasible. Therein lies the advantage of computational chemistry.

It is possible to employ quantum chemical molecular orbital calculation as the method of investigation. However, such computations are not only lengthy and laborious, but they do not necessarily yield bond energy data of the highest accuracy. Since the main objective of this study is to compare bond energies, it is much more desirable to employ some approach that will provide directly reliable bond energies. Sanderson (1976) described an empirical method for computing bond energies from atomic electronegativities called Stability Ratios (SR). This method yields bond energies with better than 97 percent accuracy.

The stability Ratio is given by the expression

$$SR = D/Di \tag{1}$$

where D is the electron density of the atom in question and Di is the electron density of that atom if its atomic number were the same as that of a noble gas atom in Group 8A of the periodic table of elements (Sanderson, 1976, p. 40). The latter is obtained by interpolation of a plot of the D values for the Group 8A elements. The electron density is evaluated from the expression

$$D = \frac{Z}{\frac{4}{3}\pi r^3} \tag{2}$$

where Z is the number of electrons filling the orbitals of an atom whose atomic number is also Z and $\frac{4}{3}\pi r^3$ is the volume of the total electron cloud about the atom having a nonpolar covalent radius r (Sanderson, 1976, p. 40).

The homonuclear diatomic covalent bond energy (E) for an atom is derived from the expression (Sanderson, 1976, p. 44):

$$E = \frac{37.0(SR)(r)}{n - 0.70} \tag{3}$$

where n = the principal quantum number of the highest occupied orbital for the atom in question, and SR, r have already been defined in equations (1) and (2).

According in Sanderson (1976, p. 78, footnote to Table V-l) the partial charge, q_A, on any atom, A, is

$$q_A = \frac{\Delta S}{\Delta Si} = \frac{S_M - S_A}{2.08\sqrt{S_A}} \tag{4}$$

where S_M is the electronegativity (SR) of the compound, taken as the geometric mean of the SR values of all the atoms in the compound: S_A is the SR value of the atom in question; ΔS_i represents the change in electronegativity for an atom acquiring a unit positive or negative charge. However, I have found that a better procedure for evaluating q_A is not only to consider the difference in the electronegativity of the compound (S_M) and the atom (S_A), but also to include the effects that neighboring bonded atoms have on atom A as well. Thus, the modified expression for the partial atomic charge is

$$q_A = \frac{1}{2.08 n_T \sqrt{S_A}} [S_M - S_A) + (S_B - S_A)n_B + (S_C - S_A)n_C \ldots \text{etc.}] \tag{5}$$

where n_T is the total number of terms in the brackets and n_B, n_C . . . etc. are the numbers of atoms B, C, etc., bonded to atom A. Equation (5) allows for the charge of an atom to vary in different bonding environments as it should be, whereas equation (4) makes no provision for this. However, this does not alter the accuracy of Sanderson's (1976) original approach. As shown below, the net bond energy is partitioned into ionic and covalent contributions, but only the former directly incorporates atomic charges. Any changes in the ionic portion of the bond energy due to charge variation are absorbed by the covalent portion. Thus, the total bond energy is virtually unchanged.

The bonding radius, r_b of an atom having a partial charge q is obtained from the atom's nonpolar covalent radius, r, with the relation (Sanderson, 1976, p. 80):

$$r_b = r - B_q \tag{6}$$

where B is an empirical size parameter for the shrinking of a positively charged atom or the expansion of a negatively charged atom. Pertinent values of B are presented by Sanderson (1976, p. 82, Table V-2).

The total bond energy, BE, for any two bonded atoms, e.g., A and B, is given by the equation (in kcal/mol)

$$BE(A,B) = E_C(AB) + E_i(AB) \tag{7}$$

where E_C is the covalent part of the bonding energy and E_i is the ionic contribution.The E_C term is obtained from Sanderson (1976, pp. 99-100):

$$E_C(AB) = \frac{R}{R_O}(E_{AA}E_{BB})^{\frac{1}{2}} t_C \tag{8}$$

where R = the sum of the homopolar covalent radii and R_O the observed bond distance, or the one computed by applying equation (6), in angstrom units, t_c = the fractional covalent character of the bond given by $t_c = (1 - t_i)$, with t_i the fractional ionic character. For two atoms, A and B, having charges q_A and q_B respectively

$$ti = \frac{q_A - q_B}{2}. \tag{9}$$

If more than one B atom, n_B, is bonded to A, then t_i is given by

$$t_i = \frac{q_A - q_B n_B}{(1 + n_B)}. \tag{10}$$

The ionic contribution to the bond energy is obtained from

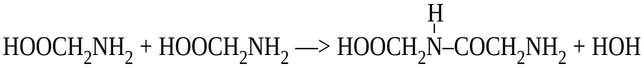
$$E_i(AB) = \frac{332 q_A q_B t_i}{R_O} \tag{11}$$

where the factor 332 converts energy units (ergs to kcal/mol).

Equations (7)-(11) may be applied for any number of bonds between adjacent atoms. The pertinent data for the atoms of the compounds of interest in this study are presented in Table III.

Results and Discussion

According to the following chemical equation, formation of the dipeptide glycine-glycine



$$HOOCH_2NH_2 + HOOCH_2NH_2 \longrightarrow HOOCH_2\overset{H}{N}\text{–}COCH_2NH_2 + HOH$$

requires the cleavage of a C-OH bond on one glycine molecule and the cleavage of an N-H bond on the other glycine, while the products involve the formation of one N-C peptide bond and one H-OH bond. The pertinent bond energies have been calculated employing the methodology described above. These data are included in Table IV together with silicino acid derivations listed as modifications 1, 2, and 3 in Table II.

Table III. Data for bond energy calculations.

Energy	SR	r^a	E^b	B
H	3.55	0.32	104.2	0.974
C	3.79	0.77	83.2	0.486
N	4.49	0.74	94.8	0.311(+), 0.063(–)
O	5.21	0.70	103.9	0.240
Si	2.84	1.17	53.4	0.587
P	3.43	1/10	60.7	0.404(+), 0.132(–)est.
S	4.12	1.04	69.0	0.681(+), 0.222(–)

[a] angstrom units (i.e., 10^{-8} cm).
[b] kilocalories per mole = kcal/mol.

Table IV. Pertinent bond energy data for glycine and its silicino acid derivatives.

Compound	Bond	BE^a	E^b_{BB}	E^c_{BF}
H_2NCH_2COOH	–C–OH	105.7		
	–N–H	87.2	192.9	
$HOOCCH_2NHCOCH_2NH_2$	–N–C	89.1		
H_2O	H–OH	107.3		196.4
		$\Delta H^d = 3.5$		
H_2NSiH_2SiOOH	–Si–OH	115.6		
	–N–H	91.0	206.6	
$HOOSiSiH_2NHSiOSiH_2NH_2$	–N–Si	92.3		
H_2O	H–OH	109.6		201.9
		$\Delta H = 4.7$		
H_2PSiH_2SiOOH	–Si–OH	118.6		
	π			
–P–H	79.5	198.1		
$HOOSiSiH_2PHSiOSiH_2PH_2$	–P–Si	64.4		
H_2O	H–OH	109.3		173.7
		$\Delta H = 24.4$		
H_2PSiH_2SiSSH	–Si–SH	75.9		
	–P–H	79.1	155.0	
$HSSSiSiH_2PHSiSSiH_2PH_2$	–P–Si–	63.0		
H_2S	H–SH	74.3		137.3

[a] All bond energies (BE) in kcal/mol units.
[b] E_{BB} = sum of all BE for bond breaking process, in kcal units.
[c] E_{BF} = sum of all BE for bond formation process, in kcal units.
[d] $\Delta H = -(E_{BF} - E_{BB})$, the net enthalpy for the reaction.

As can be seen from Table IV, the formation of a peptide bond from two glycine molecules is a slightly endothermic process, requiring only 3.5 kcal of energy. This is even less energy than that computed for the —N——H----O— hydrogen bond energy (4.4 kcal) between the two glycine molecules. Hence it is understood that the peptide bond formation process occurs efficiently at low energy, without even interrupting the critical intermolecular hydrogen bonding so important to the stability of protein structures.

The hypothetical silicino acid counterpart of glycine enters into pseudo-peptide Si-N bond formation requiring an endothermic energy input of 4.7 kcal. Thus the total energies of the bond breaking processes exceed the total energies of the bond formation process, so that the stability of the products will not be maintained in any spontaneous chemical reaction. While 4.7 kcal is not a large energy perturbation, it is sufficient to disrupt hydrogen bond formation, even if it could be compensated for by some other chemical means.

To be precise, the free energy change, ΔG, is the correct thermodynamic criterion for a reaction to be favorable. The entropy, which is not included in these bond enthalpy calculations, does make a contribution to the thermodynamic process, but it is usually small relative to the enthalpy. For example, the entropies of gaseous C and Si are 37.8 and 40.1 cal/mol-deg respectively, which amounts to an entropy difference of only 2.3 cal/mol-deg. This contributes just 0.7 kcal/mol to the free energies at an ambient temperature of 298K. If the substitution of C by Si in glycine is regarded to not alter the overall molecular geometry (as is reasonable), then the entropy will differ by only C and Si entropies *per se.* Thus, the net entropy contribution will be merely 5 percent of the total difference in ΔH for both C and Si analogues of glycine (see Table IV).

In conclusion, the implications of these results, admittedly limited at present by initial findings reported herein, are that replacements of carbon by silicon in glycine and subsequent peptide bond formation are not energetically feasible processes. Since living cells are known to have very specific protein structures formed from natural carbon based amino acids, it appears that any chemical deviations from this design may not suffice for producing viable cellular structures.

Of course, nothing stated at this point is definitive, since data have been obtained for only one amino acid and its silicon counterparts. Further work is currently in progress to determine whether the results obtained with glycine will also be forthcoming with the nine other essential amino acids comprising the structure of a model peptide.

Acknowledgement

The partial financial support of the Creation Research Society and the encouragement of the late Dr. Richard Lumsden are gratefully acknowledged.

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BOOK REVIEWS

The Great Dinosaur Extinction Controversy by Charles Officer and Jake Page. 1996. Helix Books. Addison-Wesley Publishing. New York. 209 pages. Hardcover $25.00.

Reviewed by Carl R. Froede Jr.*

What killed the dinosaurs and exactly when did this occur in Earth's past? The controversy rages on as impactors and volcanists wage open warfare on each other in the printed media. A creationist perspective on this controversy is outlined in Froede and De Young (1996). Although acknowledging that they have the less popular theory, Officer and Page provide new information to the reader about this very popular issue. This book levels serious charges against the impact modelers ranging from the inappropriate hype of "imminent earth-ending impacts" touted by NASA (so necessary to secure government program dollars to search for earth-crossing asteroids) to blatant and willful ignorance to consider or accept an opposing and better supported scientific position. This easy to read book clearly presents counter evidences which insist on a volcanic end to the dinosauria and the termination of the Cretaceous Period. Officer and Page provide the reader with a brief but thorough review of the impact theory and then begin dismantling the key evidences used to support it. If the new volcanist issues raised by Officer and Page are not addressed by the impactors it will suggest that the impact theory is one of the most embarrassing displays of non-science in recent history, akin to cold-water fusion. Within the conclusions section of their book Officer and Page present the "symptoms of a degenerative emerging scientific research program or hypothesis." Symptom by symptom they walk the reader through this sequence as it relates to the impact hypothesis. They reveal that much of the evidence used to support the Cretaceous-Tertiary boundary impact extinction event is pseudo-science. These same symptoms also fit the evolution hypothesis. I highly recommend this book to anyone interested in this topic.

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Froede, C. R. Jr. and D. B. DeYoung. 1996. Impact events within the Young-Earth Flood Model. *Creation Research Society Quarterly* 33:23-34.

The Quark and the Jaguar by Murray Gell-Mann. 1994. W. H. Freeman. New York. 392 pages. $l5.95.

Reviewed by Eugene F. Chaffin*

This work is a popular-level exposition of rationalistic evolutionism. The jaguar is used in the title as a metaphor for what is termed a "complex adaptive system." The book attempts to treat biology, physics, economics, linguistics, child development, computers, and a host of other subjects under this one umbrella. Murray Gell-Mann, the author, received the Nobel Prize in physics for his work on elementary particle theory. He introduced the idea of a "quark." Three quarks make up a nucleon, according to the results of group theory, a branch of mathematics with which Gell-Mann is highly skilled. His genius was in relating the results of group theory to the maze of data which emerges from high energy physics experiments. However, no equations are relied on in this book to make the points.

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In the early pages of the book, Gell-Mann defines *algorithmic information content* as the length of the shortest program that can produce a particular message string. Somewhat later in the discussion he defines *effective complexity* as the length of a concise description of the regularities of a system. With these definitions, he builds a picture of a universe which organizes itself, first into the elementary particles of the standard model, then into galaxies, single-celled life, multi-celled life, mammals with immune systems, humans, human societies, computers, humans with their brains wired together (p. 370), etc. The book concludes with an imagined "world in which humanity as a whole and the rest of nature operate as a complex adaptive system to a much greater degree than we do now."

Of course, it is well-known that Dr. Gell-Mann is an anti-creationist. In several places in the book he charges creationists with misinterpreting the second law of thermodynamics and expresses his belief that matter has an innate ability to organize itself. He sometimes refers to *frozen accidents* as a way to explain various circumstances. One example is the question of why certain biological molecules are invariably left-handed in living systems. A frozen accident arises from the combination of simple fundamental laws and the operation of chance. He uses the example of the succession of Henry VIII to the English throne by the circumstance of the death of his brother. In other words, the development of complex systems sometimes reaches a crucial point in history where a chance occurrence affects all future events in a decisive fashion. In this way, Gell-Mann attempts to explain away creationist arguments such as Paley's watch. He wishes to assign to matter an ability to organize itself. In other words, the book defines several new terms, discusses various complex adaptive systems using these terms, and concludes that Paley's watch could assemble itself: If it were not for our need to understand the directions in which the evolutionary establishment is headed, I would call this book a waste of time. However, one should realize that Gell-Mann is no longer a professor at California Institute of Technology, but now works at a place called the Santa Fe Institute, which he helped to start. This institute involves biologists, economists, physicists, etc. in thinking about complex adaptive systems, the future of mankind, and other high level thoughts. One would hope that such an institution would finally recognize that a Designer was involved in origins of and destiny of our planet. Based on this book, it does not seem that such an outlook on life has yet emerged at the Santa Fe Institute.

Catastrophic Plate Tectonics: A Global Flood Model of Earth History by Steven A. Austin, John R. Baumgardner, D Russell Humphreys, Andrew A. Snelling, Larry Vardiman, and Kurt P. Wise. 1996. Geology Education Materials, P.O. Box 712679, Santee, CA 92072. Slide collection, script, and supporting articles. $89.95 + $4 S&H.

Reviewed by Lane P. Lester*

This review should begin with a disclaimer: I am a biologist, not a geologist. It is that distinction that led me to obtain this excellent set of materials, because I found myself in need of additional content for my college general biology course. George Howe, Dennis Englin, and I are working on a biology textbook from the creation point of view, and I have decided to add a longer study of the history of life, pre-Flood and post-Flood. However, in order to study the history of life, one must begin with a study of the history of the earth. The materials reviewed here are very helpful.

The model presented by the authors is one in which the earth was created with a single giant continent which broke into separate land masses during the Flood. Although the model has a few resemblances to the evolutionist model of continental drift, it is framed in terms of the catastrophic effects of the Flood rather than the presumed long ages of evolution. The power of the model lies in the way that it accounts for so many of the earth's features, a number of them more satisfactorily than the evolutionist model.

The package includes 80 35mm slides, nicely filling a single standard slide tray. A script is provided in which each slide is described. You should not assume, however, that you could present this program by merely reading the script, unless you're speaking to a group of geologists. Steve Austin, the author of the script, has included a lot of technical information to make it possible to deal with questions that might arise. Anyone using this package will need to prepare a presentation with a particular audience in mind. Another point to be considered is that, although the authors of this package are six highly-qualified Ph.D.'s, not all creation scientists agree that this is the best model of earth history. Therein lies one of the attractions of slides over other media: It is easy to present the material in a variety of ways.

A quick viewing of the slides along with the script turned up a few nuisances. The slides come in "slide photo pages" as part of the looseleaf binder of materials, and they are not keyed for proper insertion into a slide tray. The script contains inconsistent usage of the metric and English systems of measurement; it would have been helpful to have included both throughout. Typographic errors in the script are rare, but most would have been caught by the use of a computer spell checker. Some of the text slides could have used more text, e.g., one which had only "Post-Flood Geology" on it should have also included from the script, "(1) tectonics, (2) volcanism, (3) sedimentation, (4) erosion, and (5) global cooling."

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A very valuable part of this package's design is the inclusion of two articles describing the model proposed by the authors. The first, with the same title as the package, is a technical presentation published in *Proceedings of the Third International Conference on Creationism* (1994). I am grateful for the second article, "Plate Tectonics: Have the Continents Really Moved Apart," from *Creation Ex Nihilo Technical Journal* (1995), which is somewhat less technical and quite readable. I am sure that, with the help of these articles, when I teach this topic it will seem as though I really know what I am talking about.

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The Mythmaker's Magic: Behind the Illusion of "Creation Science" by Delos B. McKown. I993. Prometheus Books. Buffalo, NY. 180 pp. $12.00.

Reviewed by George Sanctuary*

McKown, head of the Philosophy Department at Auburn University, has written this book in a continuing ten-year effort to thwart, or even destroy, the influence of "scientific creationism" in public education. In his introduction he divides the "world's people" into two classes: 1) ". . . those who tend to base their beliefs on facts . . . ," and 2) ". . . those who acquire their beliefs dogmatically . . . who alter or dismiss facts to fit their preexisting faith." He says his book is for the first group, about those who belong to the second group

To accomplish his purpose, McKown occasionally uses biblical arguments, which are derived without a belief in the inerrancy of the scriptures. He is convinced that "Scientific Creationists" are dressing up their biblical doctrine in the "trappings of science" (p. 41). He refers to their creedal statements to support this conviction. McKown says that biblical theories of origins are fanciful tales when compared to Big Bang theorizing. He states, "None can be expressed mathematically as Einstein, for example, expressed the relationship of energy to mass in his famous equation, $e = mc^2$. In modern scientific cosmology, any successful TOE (Theory Of Everything) will, on the contrary, be mathematically expressible" (p. 51).

I can understand where McKown is coming from, even though I accept a literal understanding of the Bible. He believes in a naturalistic origin of everything, without the need for biblical revelation. Unfortunately, he does not seem to recognize that this is a form of faith in itself.

Bible believers can learn two things from this book. First, we need to make it clear to all people that our faith is in the God of the Bible, and in His word. This is nothing to be ashamed of, or to be hidden. Secondly, creationists need to develop a simple, mathematically expressible theory for the creation of the universe — that not only fits in with the biblical account of creation, but also satisfies the observable evidence. It is true that this will involve making certain assumptions. But we know that many cosmological assumptions have been made with the Big Bang theory to explain celestial observations. These assumptions are like a creedal statement for a naturalistic origin of the universe.

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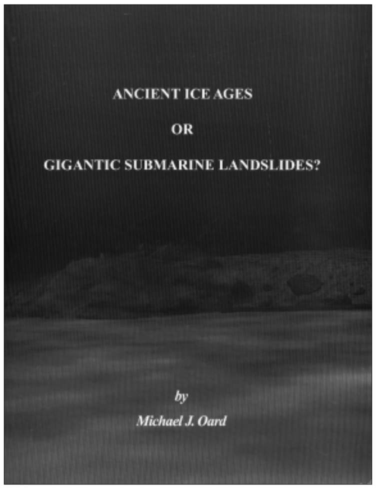
ANCIENT ICE AGES

OR

GIGANTIC SUBMARINE LANDSLIDES?

by

Michael J. Oard

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